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THE SEWERAGE PROBLEM OF THE CITY OF WORCESTER, MASSACHUSETTS.

IN order to get a clear conception of the very interesting problem of the disposal of the sewage of the city of Worcester, Mass., it is necessary to consider briefly the topography of the city and the conditions which have existed from the year 1865 up to the present time. The city is situated on hills and in valleys, and contains but little level land, the drainage of the hillsides finding its way into numerous small brooks. During the sixties the sewage of 30,000 people of the city was taken care of by cesspools, open ditches and a few covered pipes. The drainage of the city entered the nearest brook, and was ultimately received by Millbrook, and by that stream carried to the Blackstone River; several other brooks were used practically as sewers, and all but one of them were tributaries to Millbrook.

In 1867, an act was passed by the Legislature granting the use of brooks for sewage purposes, giving the city the privilege to lay whatever drains and common sewers might be necessary, and to secure the needful land, water rights, etc. Under this statute the city constructed a system of sewers which has always proved adequate to the needs of the city. The sewers discharged into the brooks, and as the brooks became seriously polluted and objectionable, they were converted into sewers. In every case masonry sewers were provided both for the flow of the brook and for the sewage which naturally discharged into it, and it was only in 1894 that the last of the work of transforming Millbrook into a sewer was completed. The building of Millbrook sewer alone cost the city $900,000, and up to the year 1886 the city had expended $2,300,000 on its whole system.

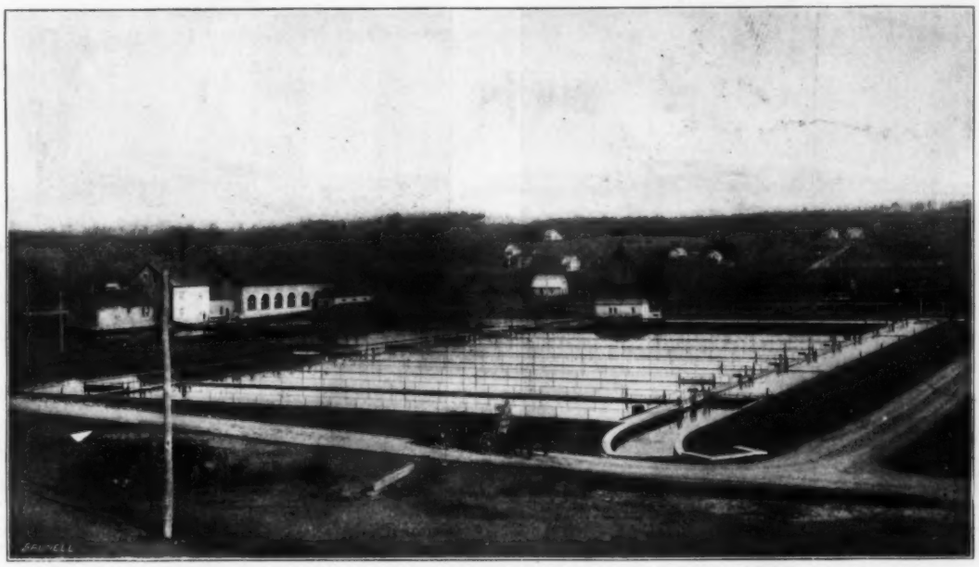


FIG. 1.—PRECIPITATION PLANT FOR PURIFICATION OF THE SEWAGE OF THE CITY OF WORCESTER, MASS.

As far back as 1880 the towns along the Blackstone River below the city made complaints which led, in 1881, to the State Board of Health making, by the direction of the Legislature, an investigation of the question, with a view to preventing the pollution of the Blackstone River by the city of Worcester. The Board reported that it was "evident that to make practicable any scheme for utilizing or purifying the sewage, it must be intercepted before it reaches Millbrook." The Board recommended a separate system of sewers for the valley; from which recommendation it is evident that as early as 1882 it was realized that any successful system for disposing of the sewage must remove the sewage from the surface water with which, by the authority of the State, it had been mixed.

The next step was taken in 1886, when the Legislature passed an act requiring the city to provide some means of preventing the sewage from entering the river, and in September, of the same year, the City Engineer submitted a complete report, in which he stated that chemical precipitation was the best method for the city to use, and recommended the erection of a suitable plant for this purpose. He also recommended that an outfall sewer be constructed from a point near the outlet of the Millbrook sewer to the site of the proposed precipitation works, and that when it became necessary to separate the sewage from the waters of Millbrook, a separate conduit from Millbrook be constructed. The construction was commenced upon these lines in 1888, and the plant was completed and the sewage was first treated in the summer of 1890. At first only a small portion of the daily flow was treated, and the work was considered to be wholly experimental in its nature. The amount treated gradually increased until it reached about 3,000,000 gallons in twenty-four hours. The beneficial results upon the river of treating so small a portion were not great, and in 1892 the number of settling basins was increased from six to sixteen. By the summer of 1893 the amount of sewage treated was increased to the maximum amount which could be forced through the outfall sewer. While the effect upon the river was very noticeable, complaints still continued to come from the town below the city; and, as the result of a complaint brought by the town of Millbury against the city of Worcester in 1895, an act "To Establish a System of Sewage Disposal for the City of Worcester" was passed, ordering the city to "officially remove from its sewage all offensive and polluted properties and substances therein before its discharge into the Blackstone River." Acting upon this order the City Engineer, Frederick A. McClure, presented a report to the City Council, in which he recommended that the entire city be sewered according to the plan known as the separate system. This scheme required two sewers in every street, one to receive the sewage from the houses and factories, which would have its outlet at the purification works, and the other to receive the surface water from the streets, roofs and brooks and discharge the same into the nearest water course. This plan required the construction of two main intercepting sewers, running nearly parallel with Millbrook and on either side of it. These two carriers, terminating at the corner of Cambridge and Millbury Streets and at the corner of Cambridge Street and Quinsigamond Avenue, are here united, and for the remainder of the distance to the outfall sewer the sewage will be carried in a conduit constructed inside the Millbrook sewer. This construction, which will require over fifty miles of new sewers, is to cost about $900,000. The work was immediately begun on the conduit inside Millbrook and also on the South Worcester and West Side separating systems.

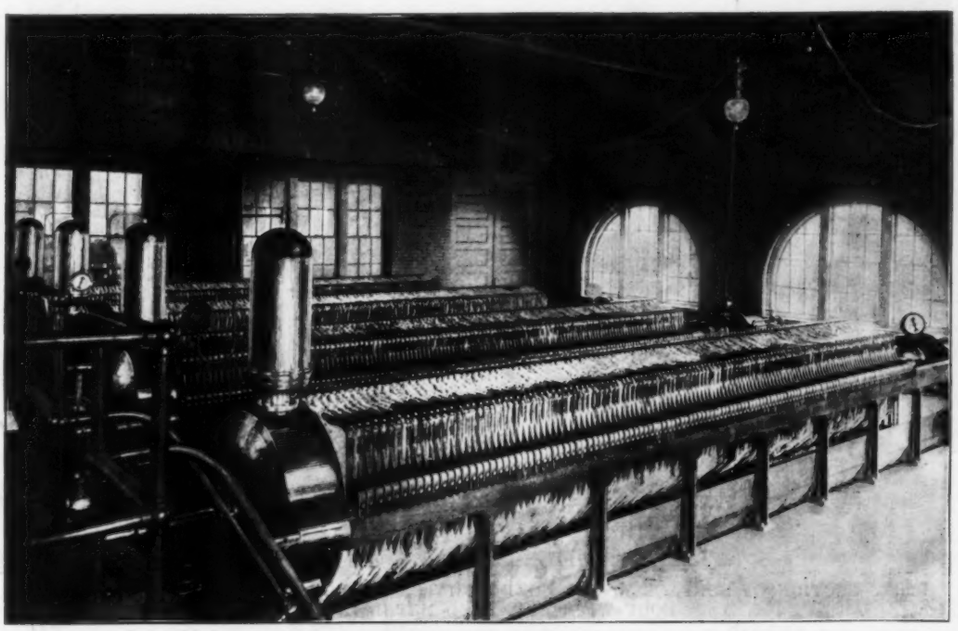


FIG. 2.—SLUDGE FILTER PRESSES AT PURIFICATION WORKS.

The method of sewage treatment adopted by the city, in 1890, and which is being carried out today, is that known as chemical precipitation, and the plant which the city now has in operation is shown in Figs. 1, 2 and 6. The method adopted is based upon the fact that when suitable chemicals are added to the sewage, a coagulation takes place, and the impurities settle to the bottom of the basins through which they flow. Our illustration, Fig. 1, shows the settling filters with the houses containing the pumps, filter presses, etc. It has been found that it is necessary to use nothing but lime as a precipitant, as there are large quantities of sulphate of iron, or copperas, in the sewage when it is received at the purification works. This copperas is in solution, and al-

though it comes in varying quantities at different times in the day, by utilizing the tanks for storage purposes, it is distributed throughout the entire flow in such uniform quantities that by the addition of lime a heavy precipitate is formed at all times. The flow of sewage through the basins is slow, and the precipitate has time, in settling to the bottom, to carry with it all floating impurities, leaving the liquid above comparatively clear. The sewage flows continuously through the basins, entering at one end of them and flowing out at the surface of the other end, and thence to the Blackstone. The sediment, which has to be cleaned out after from one to three days' use, is technically known as "sludge." It is pumped from the settling basins, where it contains about 98 per cent. water, to the "sludge" storage basins, where it settles and a quantity of clear water is drawn off onto the filter beds. The sludge is then pumped into the filter presses (Fig. 2), where the water is squeezed out from the solid matter until the sludge contains only about 65 per cent. moisture. In this condition it is readily handled by cars or teams, and is hauled on to the farms for use as a fertilizer. By chemical precipitation, about 90 per cent. of the flowing or solid impurities are removed, and a very small percentage of that which is in solution. The total purification amounts to from 53 to 54 per cent. of organic or putrescible matter.

The organic matter which remains in the effluent is nearly all in solution, so that the water looks clear and pure. This can be further purified by means of sand filters, the sewage passing through a depth of about 6 feet of sand. The sewage is turned on to the bed of sand for several hours and then shut off for the remainder of the twenty-four hours, allowing the bed a number of hours to rest and absorb oxygen from the air. This method is not as is popularly supposed, one of straining, as the organic matter in the sewage is consumed by innumerable bacteria, which form a film, or coating, around the particles of sand. As the water passes by in thin sheets the organic matter is consumed and converted into inorganic or mineral matter which cannot undergo putrefaction. In this way the amount of organic matter will be reduced 99 per cent., and the sewage can be returned to the river purer than the water in the river itself.

In addition to the illustrations of the purification plant, we present several showing the process of constructing the conduits and sewers. Fig. 7 is a cross-section of Millbrook sewer showing on the right the intercepting conduit. This main sewer which extends beneath Millbury Street, between Cambridge Street and the Blackstone River, a distance of about 4,000 feet, is built of stone and is 18 feet wide and 13 feet high. The arch has a 4-foot rise and springs from the top of vertical walls which are 5 feet in height; the invert is also circular and of the same dimensions as the arch. The sewer was so wide that it occupied a large proportion of the street, and it was deemed impracticable to parallel it with interceptors. Accordingly a

FIG. 3.—SECTION OF TUNNEL, SHOWING MASONRY AND TIMBERING.

FIG. 4.—WORKING CHAMBER OF CAISSON, SHOWING LOCK WITH BUCKET ASCENDING, LOWER DOOR BEING OPEN.

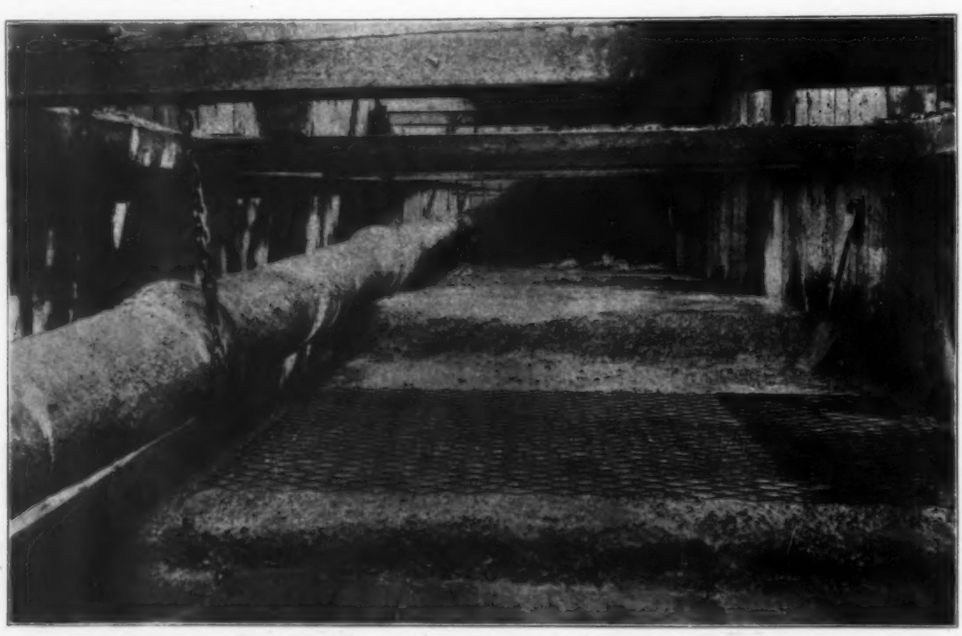


FIG. 5.—SECTION OF SURFACE WATER CONDUIT IN CAMBRIDGE STREET, SHOWING CONCRETE ROOF WITH EXPANDED METAL IN PLACE.

At left is high service water pipe, 175 pounds pressure per square inch, suspended by chains.

conduit was designed to accommodate the flow of the sewage inside the large sewer, as shown in the illustrations. The conduit has a capacity of about 50,000,000 gallons per day. Fig. 3 shows the method of building the western interceptor by tunneling. The concrete of the invert is extended to the timbering at the sides of the tunneling and the illustration shows the masonry as laid in the tunnel as well as the method of timbering adopted.

Figs. 4 and 8 are views of the caisson which was sunk upon the line of the tunnel at the corner of Temple and Greene Streets, and which served as a working chamber from which the tunnel was driven and into and out of which all materials were taken through the air locks. The caisson, which measured 18×16 feet and was 7 feet high, was lowered by the usual method. It was built of two thicknesses of 8×8 inch spruce timbers and two air locks were used, one for the men and the other for the passage of material. Fig. 4 shows the working chamber of the caisson with the lock open and the bucket going up. Fig. 5 represents a section through the surface water conduit in Cambridge Street, the roof of which was built of concrete and expansible metal, the method of laying which is clearly shown.

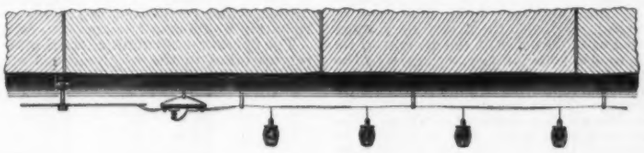
We are indebted for our illustrations and particulars of this very successful work to Mr. Harrison P. Eddy, the Superintendent of Sewers of the City of Worcester, Mass. The particulars of the plant have been taken from Mr. Eddy's last annual report to the Committee.

THE ELECTRIC PROCESS OF ANNEALING ARMOR PLATE IN THE CONSTRUCTION OF WARSHIPS.*

By CHARLES J. DOUGHERTY.

CONSIDERING the rapid development and the many applications of electricity in the past few years to the needs and requirements of engineering work, few people realize the important part which it plays in the construction of the latest type of cruisers and battleships armored with Harveyized nickel steel or Krupp steel plates. A modern battleship is nothing more or less than a floating fortress, its vitals, the machinery, being carefully protected from the enemy's shells by stout and almost impregnable steel plates, ranging in thickness up to 16½ inches. The new type of armor plate specified for the "Alabama" is the "Harveyized nickel steel plate."

For those not conversant with the "Harvey process," I will briefly state that it is the introduction of carbon by cementation into the face of an ordinary low carbon steel plate, and subsequently it is water-hardened similar to an ordinary tool. After this treatment it presents a hard faced surface to the depth of about 1 inch, designed to stop and break up projectiles before serious penetration takes place. All armor plates must necessarily be secured to the framework of the vessel in order to hold them rigidly. The plates must be drilled and tapped for this purpose, and herein lies the trouble. The methods heretofore used to produce isolated spots in the plates were principally two: (1) to protect the surface of the plate in patches or strips to prevent carburation wherever holes were expected to be drilled; (2) to make accurate drawings and patterns of each plate beforehand, to which all holes are drilled before the plate is hardened. This plan was practiced by the United States government for a time, but had to be abandoned because it was found that numerous alterations in construction, errors in the draughting room or mills made it necessary to pierce the plate where no provision for annealing was made. It was also found feasible to drill and tap holes in the face of the armor plate at any stage of the process prior to hardening, and without detraction from the plate's resistance; but it is not always possible to locate these holes with precision without first fitting the plate in place on the ship; this was a very expensive method, and was abandoned in favor of one by which the carbon was prevented from penetrating over certain areas in the wake of the fastenings. This method also had its disadvantages, in that the carbon gases frequently seeped through the protection mentioned, and carbonized the surface beneath. The expedients adopted for preventing the carburation could not always be relied upon, and the great difficulty encountered was to pierce the surface, drill, and tap such a face hardened plate. The first experiments which were made to anneal these face hardened plates by means of the oxyhydrogen flame and the electric arc were not successful, and the plates resisted most effectually all attempts to anneal the spots which were required to be drilled. Drills of every design and method of tempering were tried, but with no success; the plates could not be drilled by any of the above means. If the plates could not be held in position on the vessel, this meant serious delay in construction. The question of being able to anneal the spots required was becoming a serious matter; but as many times before in other work of difficult character, the subtile fluid was the only agent that solved the problem, so also in the case of taking the temper out of certain spots to permit the drilling of holes in the Harveyized plates, electricity came to our aid on the eve of despair and failure. The Thomson Electric Welding Company, of Lynn, Mass., made some experiments on Harveyized plates, and very soon demonstrated their ability to anneal any surface, however hardened, by sending a current of large volume through any spot to be annealed, and by this means raising the temperature of the spot to about 1,000° F.; and at that temperature there can be little doubt that the temper has been withdrawn. This is the process that I wish to treat in this paper.



SYSTEM OF LIGHTING.

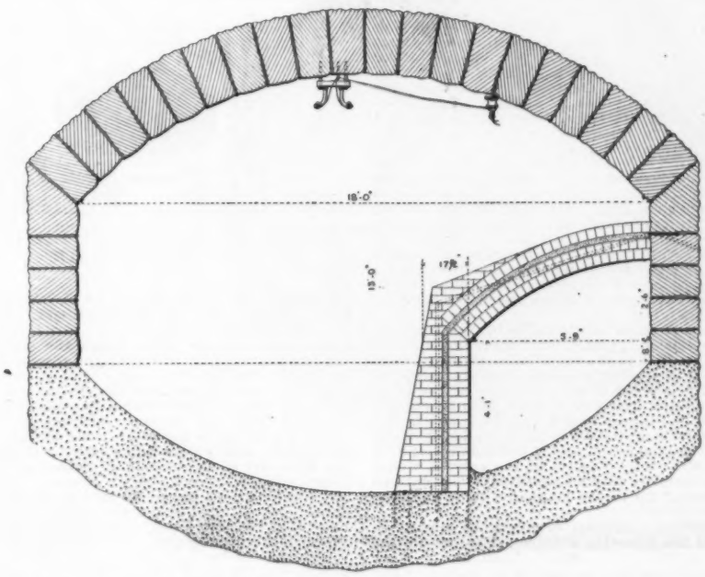


FIG. 7.—SECTION THROUGH MILLBROOK SEWER, SHOWING INTERCEPTING CONDUIT AT RIGHT. METHOD OF LIGHTING SHOWN ABOVE.

The apparatus which is necessary to perform the work of annealing these Harveyized plates consists of a separately excited alternating current generator of variable potential, giving a maximum of 300 volts and a current of 100 amperes. The frequency of the generator is 50 cycles per second; the fields are separately excited by a small direct current exciter of 110 volts and 20 amperes, made by the Thomson Electric Welding Company, and it is belted to the generator from a pulley on the commutator end of the shaft, and delivers to the field of the generator a maximum current of 15 amperes at full load. A German silver resistance box, placed close at hand under the control of the operator, varies the current in the generator fields, and thus increases or decreases the alternating electro-motive force at the brushes of the generator.

The annealing machine proper is an alternating current transformer similar to the well-known welding transformers used in welding steel rails. For those of you who are not conversant with the meaning of the word "transformer" in an electric sense, it will suffice to say that an alternating transformer may be regarded as a species of dynamo, in which neither armature nor field magnets revolve as in an ordinary dynamo, but in which the magnetism of the iron circuit is made to vary through rapidly repeated cycles of alterations, by separately exciting it with an alternating current. The primary coil of the transformer corresponds to the field magnet coil of the dynamo, while the secondary coil of the transformer may be called the armature coil of the dynamo. In the alternating current transformer, by whatever name called, the function of the iron core is to carry the magnetic lines of force (that are created by the current in the primary coil) through the convolutions of the secondary coil. The rate at which the magnetic lines due to the primary current are cut by the secondary circuit is the measure of the electro-motive force given to the secondary circuit.

With this explanation of a transformer we can understand better the workings of this annealing machine. The transformer is of the copper-clad type that is, one in which the secondary is composed of two copper castings, each having a rectangular groove; when bolted together, these form a closed rectangular frame in which the primary coil is held. The hollow space intervening between the primary and secondary is filled with a heavy body oil called "transil oil." This oil acts both as an insulator and a conductor of heat from primary to secondary. The secondary, by com-

*Read December 16, 1899, and printed in the Proceedings of the Engineers' Club of Philadelphia.

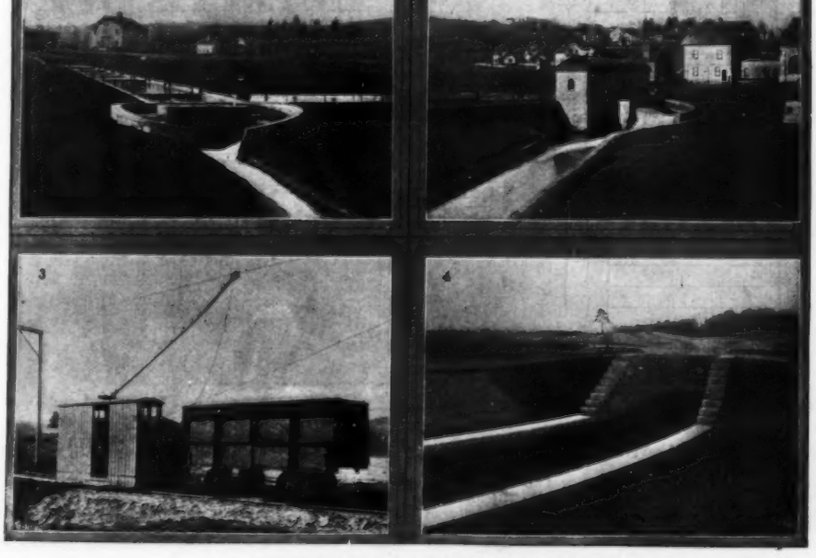


FIG. 6.—VIEWS AT PURIFICATION WORKS.

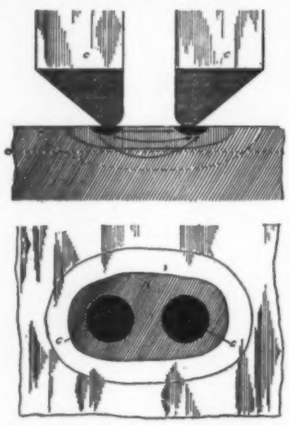
1. Spillway. 2. Spillway and Compressor House. 3. Motor Car with Sludge Car Attached. 4. Entrance to Conduit Leading to Filter Beds.

pletely surrounding the primary affords an excellent mechanical protection, and prevents electric as well as magnetic leakage. The latter features are quite important, since it is necessary to operate the annealer on board vessels in exposed positions during construction; yet it may be handled with immunity from electric shocks, even when operated in rain or in heavy snow. The primary coil of this transformer consists of a copper ribbon, each turn of the coil being insulated from the next by thin asbestos paper. The ratio of conversion is 100 to 1, and when the maximum voltage of 300 is generated at the brushes of the generator, we have about 2·5 to 2·8 volts at the terminals of the secondary of the transformer. The transformer has two trunnions fastened to its sides in a line a little above the center of gravity. These trunnions swing in bearings—part of a yoke which straddles the whole. The yoke in its turn has a hook which may be secured at any place of the arch, thus allowing the transformer to be suspended, like a compass in gimbals, in any desired position. The copper castings which compose the secondary circuit are cut through at one place. On either side of the cut two short platforms form the base for a saddle which holds the copper contacts of various shapes and sizes, by means of which the current is made to enter and leave the plate to be annealed. These contacts are made of forged copper of high conductivity, and they are hollowed out to receive a water circulation to keep them cool, and they terminate in a narrow tip which is rounded at the end. The total weight of the annealing transformer is about 1,000 pounds, and this is sufficient to insure proper contact pressure for all work on horizontal plates. When inclined surfaces are to be worked upon, the machine suspended so that its weight shall not interfere with the contact pressure, which is then obtained by bracing the contacts directly with wooden wedges against any object near by. Perhaps the most remarkable thing in the operation of annealing a spot is the great amount of current that is carried by the copper contacts into the plate. The contact surface on the plate is seldom more than about half an inch square, yet 10,000 amperes are made to flow through it during the process of annealing. This current density per contact area is equivalent to 40,000 amperes per square inch, a density which is only rendered possible through the thorough cooling of the copper contacts by a continuous water circulation through them, as I have before mentioned.

In the original experiments made by the Thomson Company in annealing plates, one feature presented itself in the fact that in taking off the heating current when the spot was being annealed caused the heat to be so rapidly conducted away by the surrounding mass of metal that the heated spot became chilled, just as if it had been plunged into cold water. No manner of outside protection of the heated spot would prevent this chilling effect, and it was found that only a gradual and slow withdrawal of the current would produce the complete effect of annealing. The current must be brought up to the maximum value and then gradually cut down.

The interesting operation of annealing a plate is performed in the following manner: The transformer is placed in position, the contacts touching the plate on either side of the spot marked for annealing. Then the primary current is brought up by means of the rheostat, near at hand, to from eighty-five to ninety-five amperes for a period of from four to five minutes. The metal between the two contact places soon attains a dull red heat, and this temperature is experimentally found by holding a small pine stick in contact with the spot until it takes fire. This is the maximum temperature desired to anneal the spot properly. The current is now gradually diminished by turning the rheostat handle one point each minute until all the resistance is placed in circuit, and by this method the spot is gradually cooled and the chilling of the plate prevented. To illustrate the method of introducing the annealing current into the plate, I shall refer to the Fig. *C C* are the two copper electrodes, the current enters the plate by one end and leaves by the other, as shown by the arrows. Right under the contacts the metal comes to a bright cherry heat, shown in heavy black in the figure, while the portion intervening and partly surrounding the contacts acquires a temperature of just visible red. Line, *B B*, indicates where the influence of the Harvey process stops. The shaded portion in the figure shows the zone softened and ready to be drilled, while the dotted line shows how far the heat radiation would cause the metal to turn blue.

The operation of running a heat after the machine is set up takes in the neighborhood of from fifteen to twenty minutes, all depending on the size of the spot to be annealed. On examining the spot after the annealing process is finished, it is found to be a dull chocolate color, the place where the contacts have been resting is scaled and hard, and cannot be touched by a tool to the depth of a quarter of an inch.



METHOD OF INTRODUCING THE CURRENT INTO THE PLATE.

In the construction of a modern man-of-war there are many armor plates which act as shields to the guns. Some of them are circular, others oval. The only method possible to perforate these shields was after carburation and before being water hardened, up to the discovery of the electric annealing process above described; but to-day, what a change! These plates are cut in various shapes to suit the work by simply annealing a number of spots forming the shape of the hole to be cut, and finally running a cutting tool over the surface thus annealed.

It sometimes happens in the construction of war vessels that the armor plates have been made up too long to fit in their respective places, and they must have a certain length cut off after their delivery at the shipyard; this occurred several times on plates for the U. S. S. "Iowa."

When such cases occur, there are two methods of annealing the plate: First, to lay off on the plate a line of holes side by side directly across the edge which is to be cut off, in the same manner as annealing spots for ordinary drilling—a slow process, indeed, since the annealer must be set for each individual hole. Second, to gradually move the transformer along the line to be annealed, the plate remaining stationary.

It has already been mentioned that it is absolutely necessary that the temperature of any individual spot should be gradually and slowly reduced in order to prevent any chilling. The effect of gradually withdrawing the heat from one spot to any other is accomplished in the second method, by moving the transformer itself, relatively to the plate to be treated, the rate of this movement, of course, depending upon the rate at which the temperature is to fall in any particular spot to prevent chilling. The transformer is arranged to be moved along a line to be annealed, the motion being obtained by an ordinary screw with a handle, the handle being turned at a predetermined rate controlled by a watch, and it was found that the correct speed was about a quarter of an inch per minute to insure positive and thorough annealing. Thus the work can be performed in a short length of time compared to the usual method of setting the machine for individual heats. The copper contacts used can be of the simplest kind; they bed themselves into the surface of the plate, and when dragged along by the screw, raise in front of themselves a clip similar to that produced by a planing tool, and even after a day's continuous moving are found to be intact.

In cases when the transformer is moved relatively to the plate to be treated, as in the method just described, it is a rather startling thing to find a number of steel chips lying around which have been cut from the plate by the copper contacts; thus developing the peculiar phenomenon of a hard steel chip cut by a soft copper tool.

Besides annealing holes in armor plate, the transformer may be used for the reversal of the annealing process, namely, for creating isolated hard spots in soft tool steel by sending a current through the spot to be hardened until it reaches a bright cherry heat, and then suddenly removing the current from the machine.

For annealing plates for the U. S. S. "Alabama," two complete annealing plants have been at work continuously night and day, Sundays included, for a period of over six months, and upward of about 3,000 holes have been treated.

We have had no difficulty in annealing the Harveyized plates of the "Alabama," but in this age of advancement something new is constantly being invented; yesterday it was Harveyized nickel steel, and to-day Krupp's armor plates are considered superior to the Harvey or Corey plates. Krupp armor is now being placed upon all the newer vessels of our own and foreign navies.

The Krupp gas process, as it is called, is a secret, and the rights of manufacture for this country have been purchased by the Carnegie Company, of Pittsburg.

The supreme value of the Krupp armor consists in the fact that these plates enable the total weight of armor with which a ship is clothed to be greatly reduced, and the weight so saved may be appropriated to a more powerful armanent, or engines and boilers of greater horse power. Krupp armor shows remarkable toughness combined with all the hardness of the best face-hardened armor; and, unlike armor manufactured by other well-known processes, the Krupp product maintains these qualities in the very thickest armor. The thickness of the hardness of Krupp's process is about 1·7 inches to 2 inches, while the Harveyized process goes in about 1 inch. The new battleship "Maine" will have Krupp armor; the Russian battleship and cruiser now building at our shipyard will also be protected with it.

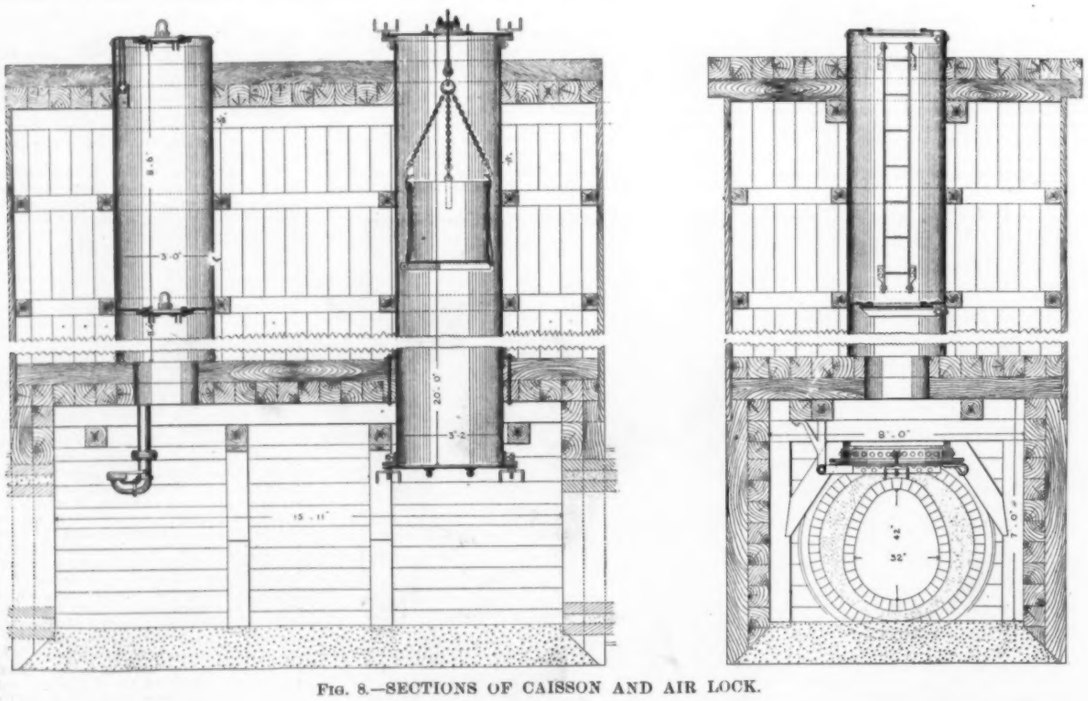


FIG. 8.—SECTIONS OF CAISSON AND AIR LOCK.

Since the Krupp process penetrates into the surface of the plate about 2 inches, we naturally imagined that it would require a greater length of time to anneal the spots, and after a little experimenting on a sample of this armor we were delightfully surprised to find that the time required to anneal a hole thoroughly was only a trifle longer than that for the Harveyized steel plate.

Twenty-three thousand men are now engaged on the irrigation works on the Nile; of these twenty thousand are natives.

THE ROBINSON SHAFT GOVERNOR.

WE illustrate on this page the latest design of shaft governor introduced by Messrs. Robinson and Auden, Limited, of the Vale of White Horse Iron Works, Wantage. Mr. Robinson, as is well known, has devoted great attention to the construction of shaft governors. These devices, though governing extremely well when new, and economical of steam, are very frequently subject to great wear and tear. To reduce this, Mr. Robinson has, to a large extent, substituted flexible blades of steel for the pivoted levers generally used. All shaft governors consist essentially of an eccentric, slotted at the center to admit the shaft. This slot permits the throw of the eccentric and the consequent travel of the valve to be altered by bringing the center of the eccentric sheave nearer to the shaft center. If these two centers are made to coincide, the valve remains at rest in a central position. It is essential for a proper distribution of the steam that the path followed by the center of the eccentric shall be a straight line. This Mr. Robinson secures by an adaptation of Watts' straight-line motion, the central bar of which is formed by the eccentric itself, while the two remaining bars take the shape of the horizontal flexible blades shown in Fig. 2, the outer ends of these blades being secured to the governor casing. Two laminated elliptical springs, secured at one end to the casing and at the other having their free extremities connected to a sliding guide-piece, are shown in a vertical position in Fig. 2. These are connected by their free ends to the shifting eccentric by means of a crosshead and screwed stud, and by their elasticity tend to keep the eccentric in a position in which its throw is a maximum. Near the center of these springs are fixed rolling spring backs connected by links to an equalizing beam, whence further links connect with the pivoted levers shown. These levers replace the moving weights usual in such governors. As they fly out under the influence of centrifugal force, they pull out with them the middle portions of the spring, and correspondingly cause an inward motion of the free end of these springs, and these being connected with the shifting eccentric as already explained, the eccentricity of the latter is reduced. It should be noted that the angular motion of the compensating beams is kept within a small limit by means of stops, so that it is not possible for one lever to move much in advance of its fellow. The line engraving and the woodcut relate, we should add, to different governors, Fig. 3 representing a smaller size than Figs. 1 and 2, but the general arrangement is identical in both.

The governor in question possesses a valuable feature in the facility with which it can be "speeded" without stopping the engine. This is effected by means of the right and left handed screw, shown near the fixed ends of the springs. This screw is actuated by means of the spur pinion shown, and by rotating the latter by a rack attached to a sliding disk mounted on the crank-shaft, the speed of the engine can be altered through quite a considerable range. We are indebted to the London Engineering for the engravings and the foregoing description.

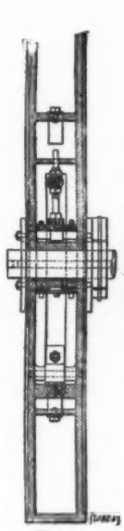


FIG. 1.

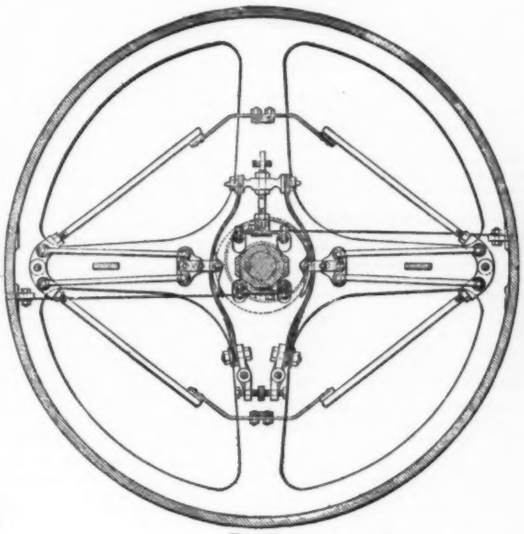


FIG. 2.

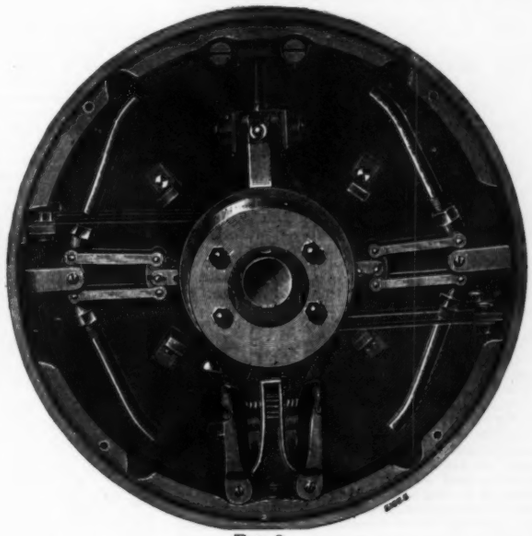


FIG. 3.

THE ROBINSON SHAFT GOVERNOR.

COMPOUND ROAD LOCOMOTIVES FOR THE WAR OFFICE.

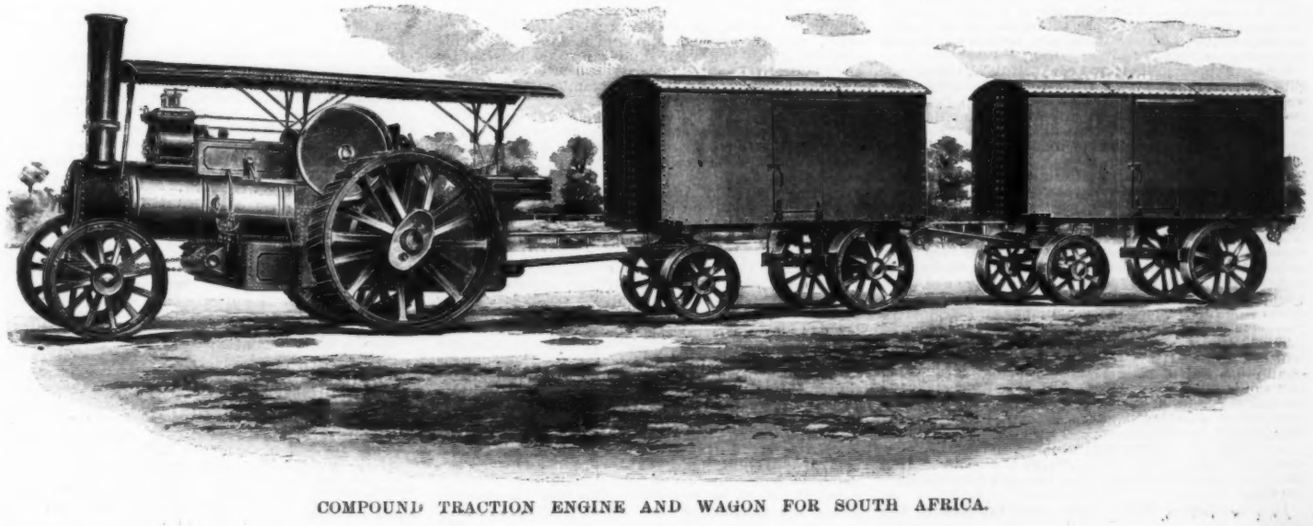
THE part which the traction engine has to play in warfare, says The Engineer, is as yet in a large measure undecided. Up to the present, however, the work that it has been given to do it has done well, and may be taken as an earnest of its capabilities of developing unsuspected sources of usefulness. We illustrate an engine and train constructed by Aveling & Porter, Limited, of Rochester, for use in South Africa. The engine is a special compound road locomotive, with the cylinder side by side. They are 7½ inches and 12 inch diameter, and the stroke is 12 inch. The crank shafts and intermediate shafts are of steel, and the best crucible steel castings are used for all the gearing. The indicated horse power of this engine is 75, and it travels at three or six miles an hour. The boiler and fire box are both of steel, and lap-welded tubes are used. The working pressure is 150 pounds, and the test pressure—for government requirements—is twice that. The grate area is seven square feet, and the total heating surface 195 square feet. The water capacity is 409 gallons. The wheels are of extra strength. They are made of wrought iron, and are 7 feet 6 inches diameter by 2 feet wide. The steering wheels are 4 feet 6 inches by 1 foot. An unusually large coal bunker and water tanks have been arranged, and a special brake acting on the insides of the rims of both driving wheels has been fitted. The engine has also a double water elevator for lifting and forcing with hoses; a governor, so that it may be used for driving a dynamo for searchlight; and a winding drum with 250 yards of steel wire rope.

The special traction wagons which are shown with the engine are constructed of mild steel and wrought iron, and are mounted on strong laminated springs. The under carriage is of steel, the wheels, like those of the engine, of wrought iron; they are 12 inches wide, and are plated up with extra tires. The bodies are entirely of steel, both frame and plating; the latter is ⅜ inch thick. There are sliding doors on each side, and powerful screw brakes and spring draw-bars. In concluding this description, we may be permitted to quote Mr. Bennet Burleigh's letter to The Daily Telegraph dated January 2, which shows that the traction engine at that time was making itself useful.

"Weather permitting, the half score or so of strong Aldershot traction engines, which have at last been detrained here and at Chieveley, will do much toward making General Buller's army compact and mobile. Without them the troops would require an astounding length of ox and mule wagons. The despised ox wagon is slow and sure. Its infallible drawbacks are that it occupies a considerable length of road, requires much guarding, with many attendants, and can only be depended upon to haul not more than 600 pounds. Nay, more, if the teams are to carry their own forage, the power of hauling is limited to something like fifty miles. Were the army entirely dependent upon trek ox-wagons, the 1,660 of them, the inconsiderable number for conveying the munitions of this army, would stretch along several miles of road. It will be another affair if the dry weather continues and any great use can be made of the traction engines. They require few attendants, don't jib, and each can easily haul twelve tons. Yesterday and to-day these wheeling Puffing Billies have been running to and fro transporting stores from the railway siding to the respective brigade camps, one of which, Hart's, is two miles away. They leisurely descend into spruits, roll across, and wheel up stiff long climbs like flies walking up a wall. Tacked on to one of the big guns they should, weather permitting, shift it rapidly from place to place, nor are they quite helpless when the ground has been soaked with rain. Clip-irons are attached to the rims of the broad wheels, and these dig into the firmer soil, and the steamer rolls forward, leaving a wake like a ploughed field. On the flat dry veldt the steamers trip along at a brisk eight mile an hour."

RAILWAYS IN THE PHILIPPINES.

"THE fact that the entire railway system of the Philippine Islands at present consists of a single line of antiquated pattern, having a length of less than 125 miles, gives some idea of the neglect of this economic form of travel and transportation under the long Spanish régime," says Cassier's Magazine. "The road intersects the rich peninsula northwest of Manila and connects that city with Dagupan, a town on the east coast of the island of Luzon, which will eventually become an important one. To be exact, the length of the line is 122 miles. The gage is 3 feet 6 inches, and the ties are of the finest hardwood, obtained from the



COMPOUND TRACTION ENGINE AND WAGON FOR SOUTH AFRICA.

forests along the line. On the entire length there are sixty iron bridges. As compared with the fairly substantial character of the roadbed, the rolling stock is very light. In speed and capacity the locomotives are insignificant, being of less than ten tons burden. The usual speed varied from fifteen to twenty miles an hour, and when the American troops took possession their railroading astonished the natives, the speeds being frequently doubled. Compartment coaches are used, and these are divided into three classes or apartments, each apartment seating eight passengers. The few first-class coaches are provided with comfortable cane chairs, while the second-class apartments have rough wooden benches, and the third-class are bare and are usually crowded with natives carrying baskets and bundles of all descriptions. An ordinary train is made up of eight or ten carriages, most of them third-class, and the fare ranges from two to five cents, Mexican, per mile. The bulk of the freight now carried is made up of rice, sugar, hemp and building material, and the rates on all classes of traffic are considerable."

MAMMOTH CAVE MAPS.

To the Editor of SCIENTIFIC AMERICAN SUPPLEMENT:

IN my article on "Mapping the Mammoth Cave," in the SCIENTIFIC AMERICAN SUPPLEMENT, No. 1229, occurs a protest against an intimation, in one of Dr. R. E. Call's scientific addresses, that I had failed to accord to other authorities sufficient recognition. I showed by page and line that due credit had been uniformly given. Dr. Call protests against the protest, denying that his remarks were meant to have a sinister bearing. Not only does my friend's disclaimer suffice, but it opens the way for me to correct an entirely excusable editorial error in the title, "The Hovey and Call Mammoth Cave Map." It was my own intention to have the composite result of several successive partial surveys styled "The Standard Map of the Mammoth Cave," thus waving all disputed claims. Certainly Dr. Call has done the latest work of revision and correction, a fact conceded in the illustrated guide manual jointly prepared by us in 1897. As to the comparative merits of the various maps of the huge cavern, we need say nothing in this explanatory note.

HORACE C. HOVEY.

Newburyport, Mass., March 28, 1900.

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

Market for American Coal in France.—The coal famine that has existed in France and a large part of Europe during the present winter and the consequent high price of all kinds of fuel have called very general attention to the coal supply of the world, says Consul J. C. Covert, of Lyons. The situation is supposed to be due to the war in the Transvaal and the strikes in the French coal districts. It could also be attributed to the unexampled activity in the channels of manufacture, which one and all rest upon coal as their foundation and have been steadily increasing their consumption for the past decade. The governments of several European nations have been asked to take prompt action in the direction of protecting their mines. During the strikes in this country the Minister of War was besieged to send men from the army to equip the idle mines and the government was requested to reduce the rates of transportation upon railroads. The first request was not complied with, but the second resulted in a reduction from the prevailing price of $2.40 per ton to $1.65 per ton for a haul from the Department du Gard, the Bouches-du-Rhône, and Cettetothe city of Lyons, a distance of 357 kilometers (about 222 miles). An effort is being made to perpetuate this low price. If successful, it will mean that if the imports of American coal which recently arrived at Marseilles are followed by continuous shipments, they could be brought to Lyons, the largest industrial center in France after Paris, for $1.65 per ton.

The area of coal territory in France covers 636,199 hectares (1,572,048 acres). These coal mines are situated in the Departments of the Nord, on the frontier of Belgium; the Pat-de-Calais, immediately adjoining the Nord; the Loire, in the center of France, St. Etienne being its largest city; the Gard, in the southeast; the Saône-et-Loire, between the two rivers from which it derives its name, where the Creusot and other great metallurgical establishments are located; the Allier, in the center of France; and Auvergne, in the southeast. The men, women, and children employed in these mines number 125,000; their total wages amount to from 152,000,000 to 170,000,000 francs ($29,336,000 to $32,810,000).

The annual coal output of France is about two-thirds of its consumption. The railroads in France consume annually about 4,500,000 tons; the metallurgical establishments, 6,000,000 tons; the mining industry, 3,000,000 tons—over half the output.

France imports and exports coal. In 1898, the aggregate importations were 9,070,436 tons; in 1899, they were 10,467,420 tons. France exports coal to Belgium, Italy, Switzerland, Turkey, Egypt, and Algeria; her total exports with what is consumed on French ships amounting in 1898 to 1,330,616 tons; in 1899, to 1,229,000 tons.

It is asserted, but not authoritatively, that France can greatly augment her output of coal. The more general opinion is that the country will have to look for her coal supply to the United States and other lands, where there are rich mines yet untouched. Some of the French mines now worked are very deep and are often flooded. The cost of pumping, timbering, and bracing averages 15 cents per ton in France against 4 cents in England. The deepest coal pits in France are in the Gard, where the miners descend 800 meters (nearly 2,500 feet).

The coal supply is the most conspicuous topic of current discussion in the French press, especially in papers of an industrial or commercial character. The possibility of a supply from the United States is freely considered. As an illustration of the rapid growth in the demand, it is stated that the amount imported into Hamburg from German mines jumped from 717,000 tons in 1889 to 1,644,800 tons in 1899; and that the importations of coal from England to Hamburg during the same decade increased from 1,580,000 tons to 2,420,000 tons.

It is mentioned that if coal were brought to the Mediterranean from the United States, the steamers which bring it would find plenty of freight to carry back from Marseilles, Genoa, Naples, and other ports.

Trade Secrets in Germany.—According to German newspapers, the German federal court has recently rendered a decision which appears to be of interest to United States consuls in Germany, as they are frequently requested by citizens of the United States to procure for them all possible information regarding manufacturing processes employed in Germany, says Consul-General Richard Guenther, of Frankfort. It appears that a foreman in the employ of a certain establishment invented a substance which his employer used in finishing "rustling" velvet. The use of this substance was considered a trade or business secret of the firm. The foreman, however, imparted the composition to others, and the firm had him tried under the law of May 27, 1898, entitled "An act for the suppression of base competition" (Gesetz zur Bekaempfung des unlauteren Wettbetriebs). The foreman was found guilty in the lower court.

The case was appealed to the federal court and the defense made the point that the foreman had only imparted his own invention to others; that the same was his intellectual property. The federal court dismissed the appeal on the following grounds:

The foreman was employed as such by the firm, and, therefore, it was his duty to try experiments by which the methods of work could be improved.

His achievement in inventing the substance was, therefore, only a part of the services which he owed to his employers, the invention belonged to his employers, and, therefore, the action of the foreman in imparting the secret to outsiders was in violation of the law referred to. Only an employee is intrusted with experiments which may lead to such inventions. A stranger whose labor does not belong to the establishment, is excluded from such experiments. The foreman was admitted to the experiments only on account of his employment by the firm, and it followed that the invention in question was made by him in consequence of his employment by the firm, for which he was paid.

Postal Service in Korea.—For a couple of years past, Korea has maintained a domestic postal service in good working order, under the supervision of a French Postal expert, M. Clemencet, using stamps printed in the United States, says Horace N. Allen, Consul-General of Seoul.

On or about January 3 last, the first mail, ever sent out to foreign countries by the Korean post was dispatched from the central office in Seoul.

The stamps used were the ones still in use in the domestic postal service and printed in the United States. A new issue has been ordered from Japan, but has not yet been received. It is possible these new stamps will not be used for long, if at all, as they are simply a modification of the old Japanese stamps and are not pleasing to the Koreans.

At present, as Korea has no steamship service of sufficent regularity to permit of a regular mail service in China and Japan, a contract has been made whereby the Korean mail pouches are received at the Japanese post offices in Korea and forwarded with the Japanese mail. The recent establishment of a regular line of Russian mail steamers to and from Korea will probably facilitate the transmission of Korean mails, as the Japanese steamship companies have seemed reluctant to carry Korean mails in competition with their own postal establishments in Korea, and the above-named arrangement with the Japanese postal authorities was the best that could be made.

The Japanese post to and from Korea will probably continue to be patronized until the Korean post is shown to be entirely reliable.

Two covers from this legation were the first to be stamped and canceled for the first foreign mail sent out from Korea.

Superiority of American Manufactures.—There have recently been a number of communications and articles in the Liverpool papers drawing attention to the fact that American manufacturers, particularly in specialties, had been accepted by English purchasers in preference to those of home production, the reason given being that the American goods were better made and handier than the home goods and were fully as cheap. Of late, says Consul James Boyle, of Liverpool, there has been a tendency on the part of the English critics to claim that American manufacturers were preferred simply because they were cheap, and it was often added they were "nasty" as well as cheap. The statements referred to at the commencement of this report refute this criticism, and the American manufacturers can now find plenty of champions in England who base their support on the ground of actual superiority, both of workmanship and adaptability. This concession has just been significantly emphasized by the publication in semiofficial form of the following letter received by the Liverpool Chamber of Commerce from a well-known business man:

I desire to submit for your consideration a summary of the observations which I have made during my close association with colonials for a period of seven years spent in Africa, Australia, and Canada, and during a brief visit to the States.

I have found that American and German manufacturers are gradually ousting us from all these markets. This truth, irrefutable from statistics, is scarcely appreciated at a time of world-wide prosperity, but it will make itself unpleasantly obvious when the inevitable reaction sets in. I find that throughout the countries I have named there is a universal complaint.

"You English will not make your goods to suit our markets. You send your samples and tell us to take them or leave them—you do not care which. If we ask you to alter things, you either refuse to do it or else you demand prohibitive prices. Germans and Americans, on the other hand, care for and ascertain our requirements, and then supply our needs at reasonable prices. Furthermore, we are in closer touch with the actual producers of American and German goods. English goods go through too many hands."

In every case I have made much careful inquiry and comparison, and I find that the German and American goods actually fetch better prices than English goods supplied for similar purposes. The reason is that the former are generally either better or more tastefully finished and are often more appropriate for the purposes for which they are made.

I find that even near home similar conditions obtain. Only last week I went into a commercial sample room in Stoke-on-Trent and saw a display of American and German "Birmingham" ware. The traveler answered my inquiries in words almost identical with the above. Further, gentlemen, I would impress upon you that the relative influence of the foreign element in our markets has most perceptibly increased with each year during the last seven years; but, be it noted, we are not undersold, but only outclassed. From a careful study of the position, I am confident that nothing but prompt measures will prevent irreparable damage. And on the other hand, I am equally confidant that by judicious and immediate action not only may the insidious progress of our competitors be stayed, but the lost ground may even be regained. That this is feasible needs no proof if my hypothesis be accepted. What is chiefly needful is a wise, intimate acquaintance with the needs of our customers and an absolute knowledge of the tactics of our competitors.

The present is a fitting moment to make thorough investigation of the condition of our trade, and I venture to submit for your consideration a method of inquiry. Let suitable persons be appointed to travel throughout not only the Empire, but the world. Equip the men so chosen with ample discretionary powers and with funds with which to purchase samples of every class of goods of foreign manufacture. Let them trace each article to its source and make a concise report under the following heads: (1) Retail price; (2) wholesale price at distributing center; (3) wholesale price at place of manufacturer; (4) import duty; (5) cost of shipment and expenses of transit; (6) number of intermediaries or middlemen; (7) suggestions as to suitability or otherwise for the purpose intended, and general remarks.

Let them also purchase similar articles of English manufacture and report likewise. The two samples should then be sent for exhibition to the center of the industries affected. A shrewd man, too, might make most valuable suggestions as to future trade and local requirements.

One of the many causes operating to our disadvantage is that English merchants frequently overlook the immense distances from railway communication of many of our colonial markets—so great are they that often the freight exceeds the value of the article. Germans and Americans study this and make their goods lighter, but equally suitable, and consequently more salable.

United States Commercial Publications in Beirut.—Consul Ravndal writes from Beirut, January 29, 1900:

I receive many inquiries from local merchants which do not admit of the delays involved in writing home for information, and cablegrams are expensive and often unsatisfactory. It would be advantageous to have United States commercial and industrial papers in the consulate. Trade Associations in the United States should see to it that American consuls at distant posts receive regularly such publications as will keep them in touch with trade movements and price fluctuations in the various branches of commerce and industry at home. We receive some monthlies, but no commercial newspapers of a general character.

The Bureau of Foreign Commerce would call attention to the fact that statements are frequently made by consular officers in regard to the value of trade journals in furthering United States interests in foreign countries. The Department has no fund for supplying these publications.

Exports of German Coal.—The Chamber of Commerce of Mannheim yesterday (February 20, 1900) sent a petition to the German Parliament (Reichstag) praying for the repeal of the tariff relative to exported coal, says Richard Guenther, Consul-General of Frankfort. Attention is called to the increasing exportation of coal and coke. The statistical tables show the following figures from 1895, inclusive, up to 1899, inclusive. The figures are for tons of 2,200 pounds:

Year.	Quantity. Tons.	Value.
1895	10,700,000	$17,289,000
1896	11,600,000	21,500,000
1897	11,500,000	22,786,000
1898	13,600,000	29,714,000
1899	12,700,000	27,881,000

It is stated that the largest part of these exports is obviously for the purpose of enabling foreign industry to compete in the markets of the world with German manufactures, and has been to the advantage of all non-German Europe.

This so-called assistance of foreign competition is all the more keenly felt by the German industry as coal is scarce, and, while prices have advanced to exorbitant figures, it is asserted that, according to reliable information, German coal is sold in foreign countries at cheaper prices than in Germany.

While it is stated that no objections are raised to exportation of coal in times of little demand, such exportation at present, when many manufacturers are threatened with the prospect of shutting down for want of coal, is a damage to the entire German national prosperity, and a remedy is asked for as a pressing necessity.

INDEX TO ADVANCE SHEETS OF CONSULAR REPORTS.

No. 681, March 19.—Proposed Railway in the Azores—Trust in Bleaching Trade in Great Britain—Exports of Columbian Cattle to Cuba—Canadian Meat and Poultry Exports—Paper, Aluminium, and Cotton Manufactures in Quebec—*Postal Service in Korea.

No. 682. March 20.—Merchant Marine of Russia—*Trade Secrets in Germany—American Trade in Syria: Correction.

No. 683, March 21.—Scarcity of Coal in Austria—Coal Miners' Strike in Saxony and Bohemia—*Coal Famine in Europe—*Exports of German Coal.

No. 684. March 22.—*Market for American Coal in France—French Coal Industry.

No. 685. March 23.—Commercial and Industrial Conditions in Switzerland—*The German Jute Industry.

No. 686. March 24.—Superiority of American Manufactures—Custom House Fines in Mexico—Excise on Wines in the Netherlands.

The Reports marked with an asterisk (*) will be published in the SCIENTIFIC AMERICAN SUPPLEMENT. Interested parties can obtain the other Reports by application to Bureau of Foreign Commerce, Department of State, Washington, D. C., and we suggest immediate application before the supply is exhausted

TRADE NOTES AND RECEIPTS.

Leather Dressing.—This dressing which imparts gloss to blacked leather is applied with a sponge. Dissolve in 5·0 of water, 4·1 kilogrammes of powdered gum arabic and add to the solution: dark copying ink, 9·0 kilogrammes; denatured alcohol (95 per cent.); and powdered sugar, 2·2 kilogrammes.—Neueste Erfindungen und Erfahrungen.

Increasing the White Silver Color in Copper Silver Alloys.—The blanching of alloys of silver and copper is best accomplished by annealing the alloy until it turns black on the surface. Now cool in a mixture of 20·0 of concentrated sulphuric acid to 1 liter of distilled water and leave therein for some time. In place of the sulphuric acid, 40·0 of potassium bisulphate may be used per liter of liquid. Repeat the process if necessary.—Journal der Goldschmidekunst.

Celluloid Coating for Veneers and Parts of Metal.—Latterly wooden veneers are coated, by machine, with an exceedingly thin layer of celluloid and next receives a high polish in the customary manner, whereby the grain of the wood becomes more prominent. Such veneers may also be coated with a transparent colored layer, without the veneering becoming covered up. The veneers treated according to the process present the advantage that the polish is more durable than ordinary shellac polish. Same is not injured either by contact with hot water. The veneers can not only be washed off with hot water, but can be laid like paper over thin card board edges, etc. They may also be pressed rather high without injury to the gloss.

In this connection we would state, that solutions of celluloid and similar pyroxylin preparations in aceton, acetic-ether etc., are now recommended for covering iron parts especially on bicycles, to protect them from the action of the damp air, thus preventing rust. The application of these solutions is done with a brush or by dipping the article into the solution at a temperature of about 40° Celsius, which operation is repeated until a sufficiently thick coating of the nature of an enamel has formed. The coating may be tinted with colors or metallic powders. In order to facilitate the adhesion, the metal is roughened, or it is given an ordinary coat of paint, which serves as a foundation for the celluloid covering.—Hannoverisches Gewerbeblatt.

Sterilization of Water with Lime Chloride.—A. Lode has instituted exhaustive studies on the sterilization of water by the process indicated by Traube, which is based upon the admixture of slight quantities of lime chloride to the water, and recommends it for its cheapness and usefulness.

In order to disinfect and sterilize 1 liter of drinking water, 0·15 gramme of dry chloride of lime is sufficient, which is stirred with a little water into a thin paste. Same is introduced, with stirring, into the water to be disinfected and 6 drops of officinal hydrochloric acid are added. After one-half hour the clarification and disinfection is accomplished, whereupon 0·3 gramme of calcium sulphite is added, in order to kill the unpleasant smell and taste of the chlorine.

If this method of disinfecting drinking water should not introduce itself despite its value, it always retains great importance when it is desired to disinfect large quantities of water at a slight cost. Thus, the author thinks that the modified Traube process will be excellent for the disinfection of bathing tanks. When we consider that hundreds of people often use the same water for bathing and the germs of cholera and typhoid fever retain their vitality for a long time in water, also that gonocæ may be transmitted to the conjunction of the eyes and this water is easily swallowed by inexperienced swimmers, thus giving rise to serious maladies, this inexpensive disinfecting method must be welcomed with pleasure. The author has conducted experiments with lime chloride in a bathing tank and attained a complete sterilization. — Pharmaceutische Centralhalle.

New Process for Applying Decalcomania Pictures on Ceramic Products Under a Glaze.—The new process is carried out as follows: The piece which has received the biscuit-baking is first coated with a mixture of alcohol, shellac, varnish and liquid glue or dipped into this mixture. Then the picture is transferred onto this adhesive layer in the customary manner. The glaze, however, does not adhere to this coating and would, therefore, not cover the picture when fused on. To attain this, the layer bearing the transfer picture, as well as the latter are simultaneously coated with a dextrine solution. When this dextrine coating is dry, the picture is glazed.

The mixing proportions of the two solutions employed, as well as of the adhesive and the dextrine solutions, vary somewhat according to the physical conditions of the porcelain, its porosity, etc. The following may serve for an example: Dissolve 5 parts of shellac in 25 parts of spirit and emulsify this liquid with 20 parts of varnish and 8 parts of liquid glue. Instead of shellac another equivalent gum may be used partly or entirely. The dextrine solution is best used in the strength of 10 per cent., but it may vary, especially if the place of the dextrine is taken by other gummy bodies, as tragacanth, agar, etc. As mentioned before, the articles after both coatings with the picture between them have been applied, are dried for some time. Next, the glaze is put on and the ware thus prepared is placed in the grate fire.

The process described is especially adapted for film pictures, i. e. for such, which bear the picture on a cohering layer, usually consisting of collodion. It cannot be employed outright for gum pictures i. e., for such pictures, which are composed of different pressed surfaces, consisting mainly of gum or similar material. If one desires to adapt this process to these pictures as well, the ware, which has been given the biscuit-baking, is first provided with a crude glaze coating, whereupon the details of the process are carried out as described above with the only exception that there is another glaze coating between the adhesive coat and the biscuit-baked ware. In this case the article is also immediately placed in the grate fire. It is immaterial which of the two kinds of metachromatypes (transfer pictures) is used, in every case the baking in the muffle, etc., is dropped. The transfer pictures may also be produced in all colors for the grate fire.—Neueste Erfindungen und Erfahrungen.

SELECTED FORMULÆ.

Plating of Aluminium with Silver, Gold, Copper and Nickel.—Messrs. Lanseigne and Leblanc, in the Jour. de Pharm. et de Chimie, gives the following for electrolytic baths. For plating with silver:

Nitrate of silver	20 grains.
Cyanide of potassium	40 "
Phosphate of soda	40 "
Water	1000 "

For plating with copper:

Cyanide of copper	300 grains.
Cyanide of potassium	450 "
Phosphate of soda	450 "
Water	5000 "

For plating with gold:

Chloride of gold	40 grains.
Cyanide of potassium	40 "
Phosphate of soda	40 "
Water	2000 "

For plating with nickel:

Chloride of nickel	70 grains.
Phosphate of soda	70 "
Water	1000 "

The baths are to be heated up to 140° to 158° Fah., and to be kept at this temperature. The anodes must consist of the same metal, which is dissolved in the bath.

Smokeless Flash Light.—The magnesium flash light powders commonly employed for photography make, as everyone knows, a very disagreeable cloud of smoke. M. Charles Henry has been experimenting with a view to doing away with this disagreeable feature. His results are communicated to La Photographie by M. L. P. Clerc, and are thus condensed in the Revue Scientifique:

"M. Charles Henry has endeavored to keep the magnesia that is formed as much as possible attached to a heavy substance that will not easily fly about and falls soon by its own weight—namely, the binoxid of barium. This substance, at a red heat, gives up half of its oxygen, and its salts communicate to flames a brilliancy of greenish fire, which partially corrects the undue proportion of violet and ultra-violet rays emitted by incandescent magnesia. Finally, the binoxid swells when heated and becomes capable of retaining the light powder of magnessa formed in contact with it. The sole condition to be observed, that the binoxid may be reduced with incandescence, is to remove it vigorously from all contact with oxygen. To this end, and also to insure the inflammability of the mixture, the powder is done up in collodion, whose products of combustion constitute a reducing atmosphere, adapted to the dissociation of the binoxid of barium at the lowest possible temperature; all the elements of such a powder thus play an active part at the highest point. These powders have, besides, a great advantage over those made of chlorate of potash; they are absolutely inexplodable by the stroke of a hammer, and are inodorous and without danger from the physiological point of view."

M. Henry, we are told, has prepared two types of powder that differ in their proportions of the binoxid; the first, which has only a little magnesium, gives only 45 to 50 per cent. of smoke, whereas ordinary powders give 75 to 90 per cent. The other is richer in magnesium, burns more slowly, and can be used advantageously only in a special lamp, when the proportion of smoke falls as low as 10 per cent., and the brilliancy, owing to the high temperature to which the magnesia is raised, is very great.—The Literary Digest.

Chow-Chow.—

Curry powder	4 ounces.
Mustard powder	6 "
Ginger, powdered	3 "
Turmeric	2 "
Cayenne pepper	2 drachms.
Black pepper	2 "
Coriander	1 "
Allspice	1 "
Mace	30 grammes.
Thyme	30 "
Savory	30 "
Celery seed, in powder	2 drachms.
Cider or wine vinegar	2 gallons.

Mix all together, and let simmer over a slow fire for three hours. The pickles should be scalded or slightly parboiled with boiling salt water, and the spiced vinegar poured over them while still warm.—National Druggist.

Etching on Steel.—To etch on steel, the first step to be careful about is to have the print heavy inked and then powdered up with dragon's blood several times before starting to etch. To do this properly every operator has noticed that after powdering and slightly heating, additional powder will stick, and will form a heavy coating in two or three operations with the powder. Before proceeding to heat up good, the plate should receive a light etching in a weak solution of the acid described later on. By giving this etching, the print is cleaned up, and will not thicken up the lines, as would be the case without this etching. Then a good strong heating should be given. On top the dragon's blood plumbago may be used in addition. For etching use nitric acid mixed with an even amount of acetic acid. Some operators use vinegar, based on the same theory. When commencing the etching, start with a weak solution and increase as soon as the plate is deep enough to allow another powdering. If the operator is familiar with lithography, and understands to roll the print up with a litho-roller, the etching of steel is not harder than etching on zinc.—Process Review.

Clarifying Vinegar.—The Era Formulary gives the following formula for a "clearing powder" suitable for vinegars, wines, liquors, etc.:

Albumen	3 pounds.
Neutral tartrate of potassium	4-5 ounce.
Alum	½ pound.
Ammonium muriate	½ "

The powder must not be added direct to the liquid to be cleared, but should first be mixed with soft water. About 20 grains of this powder are said to be sufficient for clearing a gallon of fluid.

MISCELLANEOUS NOTES.

Mr. E. H. Benjamin, secretary of the California Miners' Association, has begun, in co-operation with the testing laboratory of the University of California, a series of tests of steel-wire cables. From tests made, the following conclusions have been arrived at, viz.: 1. That the effect of ordinary rust on the strength of steel-wire cables is not as great as has commonly been supposed, and that the rusting may be almost entirely prevented by carefully coating with tar, etc. 2. That the weakening effect of bending the cable around a drum, of large size compared with the diameter of one cable is almost nothing. 3. That the cable which exhibits a great deal of wear on its exterior surface, and is apparently much diminished in strengtn, is not nearly as much weakened as is commonly supposed, and retains a large percentage of its original strength, particularly when stressed by gradually increasing loads, applied without shock.—Mechanical Engineer.

There is a problem on which chemists might try their ingenuity, not so important, but not insignificant either. Mineral water bottles are often secured with the aid of rubber washers or rings. The peculiar smell which adheres to these washers may be pleasant to the rubber manufacturer; for it is a sign that some real Para rubber has been applied. But the smell and taste are decidedly unpleasant and quite strong enough to make people thoroughly dislike the water which, when poured into a glass, appears to have a nauseous odor of its own. The problem is not easy. The science of smells and odors has been much neglected. Sawer tried his skill on it in his odoragraphia in 1892. Prof. Ayrton made it a subject of an address before the British Association at Bristol in 1898, and now we notice a paper by E. Erdmann in the Zeitschrift für Angewandte Chemie. Erdmann does not trouble about the nature of the odor of metals, etc., but wishes to establish the connection between scent and chemical constitution, as others are investigating the connection between constitution and color.

Lyddite and Melinite.—These two explosives are practically identical, and if the Boers have not yet been very successful in bursting their melinite shells, we may be sure it has not been from motives of humanity. Lyddite is simply picric acid brought into a dense state by fusion. The shells are coated inside with a special varnish, and the melted picric acid is cast into them. As this requires a strong detonator, or a very powerful primer, the government is said to have adopted a primer of picric powder, which consists of a mixture of two parts of ammonium picrate to three parts of saltpeter, manufactured in much the same way as ordinary granulated gunpowder. This is then set off by the ordinary service fuse. Melinite was originally picric acid, embedded in a collodion solution, and later on also fused picric acid. A mixture of fused picric acid and creosylic acid is now employed. Although picric acid was used as an explosive in the pulverulent state, mixed with saltpeter and other ingredients, yet the property of detonating with great violence when melted, was first indicated by Dr. Herman Sprengel, and afterward patented by Eugene Turpin, of Paris.

Many materials have been used as media in the filtration of sewage, and among these coal has given very good results. At the Wolverhampton sewage works there is, as we learn from a paper read before the Institute of Sanitary Engineers, by Mr. Ernest Berrington, a coal filter, 40 feet 6 inches long by 20 feet wide by 5 feet deep, with an area of 90 square yards, which is doing excellent work. It is constructed as follows: A layer of 6 inches of coal about ½ inch cubes in size, is laid over the drain-pipes. Above this comes a 3-inch layer of ¼-inch cubes, and above this 3 feet 9 inches of ⅜-inch cubes. The top layer consists of 6 inches of fine coal dust. The sewage is applied by means of perforated pipes laid on the surface, and is allowed to percolate through the filter continuously. At the present time this filter is allowed to work for twelve hours, and is then allowed to aerate for a similar period. The rate of filtration is about 200 gallons per square yard, equal to one million gallons per acre per day. The sewage is first precipitated in tanks, and the tank effluent passed through the filter. The analyses show the purification on organic ammonia effected by the tanks on the raw sewage to be 85 per cent., and 98·2 per cent. by the tanks and filter combined. On the "oxygen absorbed" test the purification of the tank effluent is 91 per cent., and on the "organic ammonia" the purification of the filter on the tank effluent is 88 per cent. These results show that coal makes a very effectual filtering effluent.—Engineering.

A septic tank system was put in operation at Barrhead, Scotland, on June 15. According to The London Contract Journal, it is designed to serve a population of 10,000 and to treat a maximum flow of 480,000 United States gallons of sewage and storm water. The sewage passes, unscreened, through two grit chambers to four septic tanks, each 18 × 100 feet, × 7 to 8½ feet deep. The normal depth of 7 feet gives a total tank capacity of about 375,000 United States gallons and the maximum depth 460,000 gallons, the variation being designed to accommodate storm water. The tanks are covered with concrete and steel arches, resting on brick piers. From the tanks the sewage passes through slotted pipes to an effluent chamber, and thence through flow-regulators and aerators to two outlet chambers, each supplying sewage to four filter beds. The admission of sewage to the filter beds, and the discharge of sewage from them is automatically performed by means of the overflow of a small quantity of effluent. Each of the eight filter beds is 54 × 55 feet, giving a total area of a little over a half acre. The filtering material is 4 feet of broken furnace clinker. Ordinarily only six filters are used, two being kept in reserve. Five tanks are idle, or resting, while the sixth receives the effluent from the septic tank, which is discharged on the surface by means of stoneware channels. The effluent remains in the bed about ninety minutes when the discharge valve opens and air takes the place of the sewage. The system is controlled by the Septic Tank (Foreign and Colonial) Syndicate, Exeter, England, of which Cameron, Commin & Martin are managing directors and engineers.—Engineering News.

ENGLISH ARTILLERY IN THE TRANSVAAL.

IN the different engagements that have taken place in the Transvaal, the English artillery has shown itself to be thoroughly inadequate. The reason of this is easy to give. The department of artillery, which, during the course of last year, adopted a rapid-fire field gun, was surprised by the abrupt declaration of war, and was obliged to renounce the idea of constructing new material. The English troops are, therefore, making their South African campaign with the old material, which comprises guns that are designed, some of them for mounted batteries and others for horse batteries. All of these have the same caliber of 3 inches, the length of the chamber alone differing. The guns reserved for the cavalry are shorter and therefore lighter. The weight of the projectile of the light gun is twelve pounds, and that of the heavy one fifteen. The English designate these two guns by the weight of their projectile, and style them "15-pounders" and "12-pounders." In doing this they have preserved the appellations in use at the time when guns were loaded at the muzzle.

These pieces fire three kinds of projectiles: the ball-shell or shrapnel, the case-shot, and the lyddite shell. The shrapnels, designed for bursting just before touching the ground and covering the enemy with their fragments, contain two hundred balls each, as well as a charge of 750 grains of powder. The fuse acts both as a burning and percussion one. The case-shot, designed to be used against surprises by the enemy, contains 300 balls. Its range of action does not exceed 500 yards.

Finally, the lyddite shell, which has led to protests on the part of the Boers, is employed especially for the destruction of earthworks, forts, batteries, parapets, etc. It contains lyddite, an explosive material of great power and analogous to melinite. The name of "lyddite" was given it because it was first manufactured at Lydd, in the county of Kent.

It is claimed that such a shell, exploding in the midst of a battalion formed en masse, would totally annihilate it without the cadavers showing any trace of a wound.

The great defect of the English guns is that they are slow-firers. They belong to the old material in which the loadings were effected in succession. Moreover, after each shot, the piece must be put back in battery and the pointing renewed; whence results a great loss of time. The English gun is, therefore, a weapon inferior in every respect to the extra rapid gun constructed by the Creusot works and employed by the Boers.

In order to compensate for such inferiority, the English have sent to the Transvaal a certain number of Maxim automatic guns of a caliber of 1·45 inch (Fig. 1). In these pieces everything is done automatically, the loading, the firing, and the extraction of the cartridge shell. All these motions are produced by the recoil resulting from the expulsion of the projectile, and the return to battery controlled by a counter spring. The result is a very rapid fire, since the man who serves the piece has nothing to do but keep the line of sight upon the mark and his finger upon the trigger.

The piece is provided with two brakes, one hydraulic, designed to limit the recoil, and the other consisting of a strong spring with three spirals for causing the return to battery.

The gun, properly so-called, is inclosed in a bronze jacket containing water designed to keep the chase constantly cool. In the train of a firing of 600 shots a minute, this part of the gun, in fact, soon becomes quite hot, and communicates a portion of its calories to the water of the jacket. The liquid soon enters into ebullition and becomes converted into steam, which escapes through an aperture formed in the body of the jacket. The piece is supplied through a belt carrying the cartridge magazine. The ammunition used in the Maxim rapid-fire guns is, in fact, a true cartridge analogous to that of the infantry gun, and differs therefrom in size only. It comprises a shell, a charge of powder, and a ball held in place by a bezel. The ammunition is fixed to the belt by means of clasps and is placed in a box which is adapted to the piece itself. This arrangement facilitates the unwinding of the cartridge-carrier in measure as may be required.

The gun is provided with a safety arrangement that prevents the hammer from striking the cartridge before the closing of the breach.

We have above stated that in order that the firing may be done continuously the gunner must keep his finger upon the trigger. But shot by shot may be fired at command by simply pressing the trigger and then releasing it. The rapidity of the firing may be regulated by the action of the two brakes, the spiral spring and the hydraulic brake.

The field gun is supported by a pivot that permits it to take on a rotary motion. The gunner, in resting his shoulder against the butt end can, therefore, give a motion to the gun from right to left, and vice versa, so as to sweep the field in front of him.

The following are a few data to complete the above brief description:

Caliber	1·45 inch.
Length of gun:	
Without butt end	6·25 feet.
With " "	7·25 "
Weight of empty shell	14 ounces.
Explosive charge	195 grains.
Weight of projectile, full	14·25 ounces.
" " cartridge shell	4 "
" " charge (smokeless powder)	1·25 "
Initial velocity	1,809 feet.
Penetration of iron at 500 yards	2 inches.
" " " " 600 "	1·4 "
Weight of gun	416 pounds.
" " carriage	766 "

This piece is used not only as a field gun, but is mounted also in fortified works, upon disappearing carriages, and upon pivoted carriages on board of vessels.

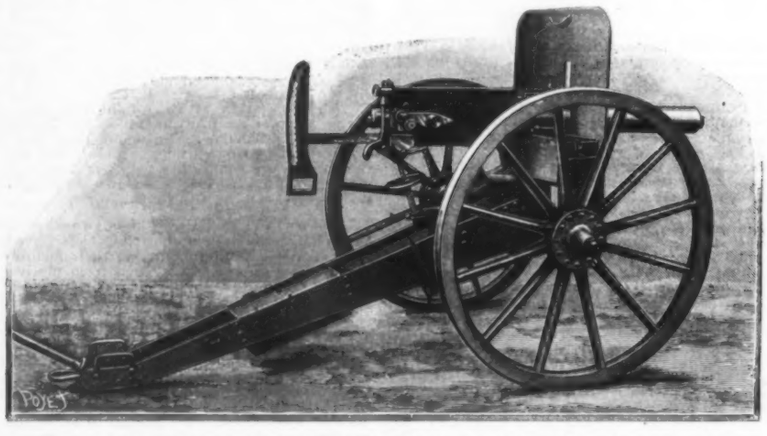


FIG. 1.—A 1·45-INCH MAXIM AUTOMATIC GUN MOUNTED UPON A FIELD CARRIAGE.

Such is the Maxim automatic field gun, which, at the time of its advent, the French navy endeavored to utilize. Unfortunately, despite various improvements introduced into the mechanism, the piece has remained of extreme delicacy. Since it necessitates experienced gunners who are acquainted with every detail of it, it seems to be but slightly adapted for naval use, and on this account, has been totally discarded.

It seems strange that the English should have thought of using in the field, despite the difficulties of carriage maintenance and repair, a weapon that had already been found to be too delicate for use on shipboard where every convenience is at ones disposal. Moreover, it may be asked, what effects such guns are capable of producing when opposed to pieces of calibers varying between 3 and 3¼ inches. The projectiles thrown by the automatic gun are eight times lighter than those with which ordinary pieces are provided. Moreover, the fragments that they produce and the balls that they contain are less in number than those of shrapnels. We shall, therefore, be in nowise astonished some day to learn that the authorities have relegated these too complicated weapons to a secondary rank.

In order to reinforce their infantry, the English have provided their battalions with a certain number of Maxim machine guns (Fig. 2); but, since the operation of these is based upon the same principle as that of the automatic gun just described, we shall not revert to it. It will suffice to remark that the machine gun has the same caliber as the infantry one. It is due to such an arrangement that is avoided the regrettable confusion that would certainly occur were it necessary to have a double supply of ammunition, rifles and machine guns to be managed by the same hands.

The speed of firing obtained with the machine gun may reach from six hundred to seven hundred shots a minute. The magazines contain a sufficient supply of cartridges for from fifty to four hundred shots.

The gun may be placed upon any kind of a carriage, or upon mule back. A smaller model has been constructed, called a high "light machine gun," which may be carried upon a frame attached to a cavalryman's saddle or to the back of a foot soldier.

The firing is done either upon a carriage or upon a tripod. The machine gun may likewise be arranged upon the parapet of fortifications or upon board of ships.

The light machine gun weighs but 25 pounds; and, with its complete equipment, 57.

The defenders of the machine gun claim that it increases the power of a battalion by a third. Admitting that this unit comprises 1,000 guns, we should have to conclude from this that four of these pieces would be equivalent to 250 men. A single gun would, therefore, produce the same effect as 63 foot soldiers.

There is here a consideration that is certainly not to be despised. It remains to know whether or not practice has responded to the hopes that the English founded upon their machine guns. It seems that it has not. In fact, in a somewhat rapid firing, the water contained in the jacket quickly enters into ebullition and evaporates; and the loss of the liquid is then very perceptible. In order to remedy this, it is necessary to introduce into the receptacle, on an average, a quart of water per minute. This is a complication that it is impossible materially to oppose.

It appears that the Boers have no machine guns. The successes that they have obtained since the opening of hostilities permit us to conclude that they have had no cause to regret it.

For the foregoing particulars and the engravings, we are indebted to La Nature.

A NOVEL APPLICATION OF ELECTRIC HEAT.

By E. J. HART.

THE authorities of Marquette, one of the most prominent towns in the upper peninsula of Michigan, believe they have hit upon a plan of warming the water of Lake Superior on an electric stove before admitting it, through the intake pipe, to the city water works system, and by carrying their plan into effect at a cost of $25, they consider they have averted the necessity for changing the location of the pumping station and intake pipe at a cost of from $50,000 to $100,000.

For many winters past the city has been greatly bothered by ice from the lake, which has choked up the intake pipe so as to entirely shut off the water supply and necessitate the closing down of the pumping station. This has occurred dozens of times in the past few years, and water famines have resulted annually. It has been necessary in each case of a "choke-up" to thaw out the mouth of the intake with salt, but this has only remedied the evil temporarily, and after some delay and a great deal of trouble. The trouble has grown to such proportions that the question of spending many thousands of dollars to change the location of the intake pipe and pumping station had been agitated.

The trouble at Marquette was not with the surface ice of the lake, but with "needle ice," as it is called. When the lake freezes over the water supply is not affected, and the surface ice is rather a protection to the intake. The trouble comes, however, when the ice fields are carried out of the bay by winds, and the same winds prevent new ice from forming on the surface. Small particles of ice—"needle ice"—form, and then millions of the particles mass together and are carried into the intake pipe. The vertical section of this which admits the water is 2 feet in diameter, but the masses of ice are sufficient to entirely block it.

About three weeks ago a famine of unusual severity resulted from an ice blockade of this sort, and the

FIG. 2.—A 1·45-INCH MAXIM MACHINE GUN MOUNTED UPON A PIVOT.

city water board solicited the assistance of some local engineers to remedy the trouble; if possible, permanently. Superintendent Charles Retallic, of the municipal electric light and power plant, was one of these, and he devised a plan by which it is hoped to do away with the evil entirely. The plan provides for an electric heater of cylindrical form, hung concentrically within the opening of the vertical section of the intake pipe. This heater was completed and put in place last week, and it will be tested as soon as the wind again carries away the surface ice and the conditions are suited to the formation of the fine ice particles that cause the trouble.

The heater is of the iron resistance coil pattern, and the only novelty about it lies in its adaption to the use for which it is intended. It consists of an inner and outer drum of galvanized iron, respectively 19 and 21 inches in diameter, and both 5 feet in length. The inner drum has flanges at the ends extending outward, and to these the outer drum is soldered. The inner cylinder was wrapped with asbestos sheeting to a depth of nearly half an inch, and around this were wrapped convolutions of No. 18 iron wire, in one continuous spiral. Terminals were carried through the flange at one end through water-tight gaskets of heat-proof insulating material. Iron shoulders are riveted to the apparatus and by means of these it is hooked over the top of the intake pipe. It extends from the top of the vertical section of the intake to within 2 feet of the horizontal section, and the former only stands 7 feet high.

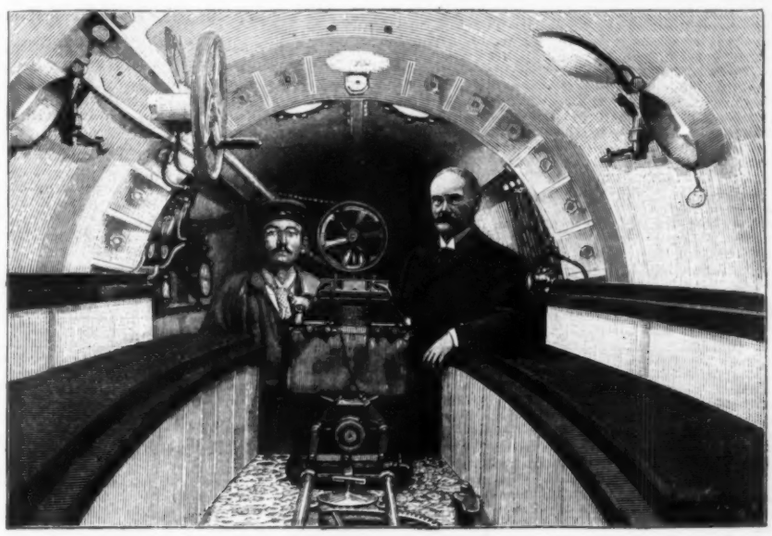
Current is supplied from the electric light wires at the water works plants on the beach. It is carried through conductors intended for submarine service, and where the wires enter the water they pass through a conduit of iron piping to protect them from shore ice. The stove will generate enough heat, it is believed, to melt all the needle ice before it passes through the cylinder. The plan is not to keep it in constant use, but only when the conditions of the weather are favorable to the formation of this sort of ice.—Electrical World and Engineer.

DESTROYERS FOR THE JAPANESE NAVY.

THE Japanese navy has one marked advantage over the other great navies of the world, due to the fact that most of her ships are of the very latest types and construction. Only recently she received from the builders a magnificent 14,850-ton battleship, armed with the most approved long caliber guns and capable of a trial speed of nearly 19 knots an hour, and this is only one of a half dozen practically similar vessels which are either built or building for the same navy. She has also 6 armored cruisers, some completed and others nearing completion, which are of nearly 10,000 tons displacement and from 20 to 22 knots speed.

During the last two or three years Japan has been paying great attention to the development of her torpedo and destroyer fleet, and some two dozen of the very latest types of torpedo-boat destroyers are now either completed, or being rapidly pushed forward to their trials in various European yards. Among these are six vessels of 5,800 horse power and 30-knot speed, building at the Thornycroft yards at Chiswick; four of 6,000 horse power and 31 knots speed, building at Havre; four of still larger dimensions which are to have a maximum trial speed of 33 knots which are now being built by Schichau, at Elbing, and six vessels of 6,000 horse power and 21 knots contract speed which have recently been completed by the firm of Yarrow & Company, at their yards at Poplar, London.

The accompaning illustration represents one of these six vessels, the "Niji," the photograph being taken when it was out for a continuous trial run of 3 hours' duration the trial being carried out with a load on board of 35 tons, these conditions being the same as those demanded by the British Admiralty for their 30-knot destroyers. The speed of 31 knots was in the case of each vessel slightly exceeded, the highest speed of 31·38 knots being achieved by the "Sazanami" under an air pressure of 1·3 inches. Perhaps the most meritorious result was obtained with the "Niji," which achieved 31·15 knots under an air-pressure of only 0·9 of an inch. The boats are 220 feet long and have a beam of 20 feet 6 inches. They are driven by twin-screw engines, of the four crank, triple-expansion, type, with 20½-inch high pressure cylinder, 30½-inch intermediate cylinders and two low pressure cylinders, 34 inches in diameter, the common stroke being 18 inches. While the engines are designed to give 6,000 horse power they could be made to develop fully 7,000 if called upon. The armament consists of one 12-pounder, quick-firing gun, mounted aft, one 6-pounder forward, and four 6 pounders in broadside. There are two torpedo discharges for 18-inch Whiteheads. On the trials of the "Niji" the air pressure during the three hours varied from ¾ to ⅞ of an inch, and the consumption of coal worked out at 1·98 pounds per indicated horse power per hour, while the consumption of coal per square foot of grate was 52·3 pounds. Steam is supplied by four Yarrow straight-tube boilers. The engines are balanced on the Yarrow-Schlick-Tweedy system, which aims to reduce the vibration, the results in the present case being highly satisfactory.



Length, 220 feet; beam, 20 feet 6 inches; speed, 31·15 knots.

THE DESTROYER "NIJI," FOR THE JAPANESE NAVY.

A feature in the construction of these vessels to which attention should be drawn is the system adapted in the steam pipes for allowing variations in length. Instead of the ordinary stuffing box arrangement, allowing the steam pipes to move in a socket, there is a special swivel joint, not unlike that used in the ordinary gas-bracket, which is so arranged as to be in perfect equilibrium. In a vessel of such light construction as a torpedo boat or a torpedo-boat destroyer, provision must be made against variation in length due to changes of temperature, and it is also necessary to provide special elasticity in the piping, so that it can accommodate itself to the flexibility of the hull which, by the way, is considerable when the vessels are running in a rough sea. Messrs. Yarrow, indeed, consider that there is more risk from the working of the hull than from the changes of the temperature, the bending of the pipes due to the power cause occurring for a considerable period at a stretch, while changes due to temperature are relatively infrequent. Provision is made on these vessels for carrying from 90 to 100 tons of coal which is amply sufficient to enable them to make any of the runs between the coaling stations, on the voyage to Japan, at the rate of from 11 to 14 knots an hour.

Production of Shoemakers' Black. — Boil 2·5 kilogrammes of log wood extract, 30·0 kilogrammes of water and 0·2 kilogramme of potash in an iron kettle until completely dissolved, and stir in 0·5 kilogramme of powdered green vitrol and 0·4 kilogramme of powdered red potassium chromate. When all is cool, draw off from the sediment and fill in glass bottles.—Seifensieder Zeitung.

THE SUBMARINE TORPEDO-BOAT "LE GOUBET."

THE submarine torpedo-boat, "Le Goubet," which recently left Saint-Ouen, was carried with the greatest ease by railway to Toulon, and put into the water at the arsenal in order to undergo the experiments prescribed by its inventor.

After being provided with two Whitehead torpedoes it began its trials during the second week in November in the presence of a commission headed by Captain Lepord of the navy. These trials consisted in submerging it so that it was practically invisible and invulnerable (nothing emerging but the optical tube, and that only at intervals) and causing it to approach an enemy away from our naval and commercial ports. —L'Illustration.

M. GOUBET IN THE INTERIOR OF "LE GOUBET."

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As may be seen from the accompanying engraving, borrowed from L'Illustration, the interior of the boat is very attractive in its simplicity. It is printed entirely in white, and on each side there are varnished mahogany seats that cover batteries of accumulators. In the center, near the covering of the dome, there is a hand wheel which maneuvers a rudder frame in which the screw moves. All around the dome there are port holes through which the horizon may be inspected when the boat is at the surface.

At the rear there is a motor, a water intake of large capacity and a rotary force pump actuated by electricity. Moreover, a new electrical apparatus that may be called an automatic regulator of submersion has the effect of keeping the boat at a constant depth below the surface while it is underway.

Upon the whole, if, as is hoped, the experiments prove satisfactory, we shall be able to say that the navy possesses a submarine coastguard that is easily transportable to the colonies and capable of keeping

Chinese Hogs' Bristles.—According to the Deutsche Maler Zeitung the amount exported through the port of Tienstin last year, exceeded 600,000 kilogrammes. These bristles come in large bales from the interior of the empire to the harbor, where they are assorted, after a complete cleaning piece by piece, according to the length and laid in packages of 4 to 5 centimeters in diameter. Since there is an endless number of lengths, one can imagine the time necessary for this work. The

price of this export article being comparatively low, the wages for this laborious task are incredibly small and it is only owing to the extreme unpretentiousness of the Chinese workmen that such work can be performed at all.

THE CLASSIFICATION OF WARSHIPS.

By Fred. T. Jane.

The British public—or, at any rate, an appreciable section of it—is fond of "comparative tables" of warships. In such the class to which a ship is assigned appears more often than not to depend upon what is wanted to be proved. The Admiralty, with the "Black Prince" as an armored cruiser, the "Centurion" and "Collingwood" as first-class battleships, are easily first in setting this fashion, and every comparison attempted hampers itself by the Admiralty model.

For ourselves we attach only a limited value to comparative tables, holding that the man behind the gun and his fellows in the stokehold and engine-room constitute dominant factors. But if comparative tables are to be constructed which shall give any true idea of material, they must be made in a very radical spirit. The division of ships into battleships and armored cruisers is altogether obsolete, even if our Admiralty, with its armored cruiser "Black Prince," had not driven nails into that particular coffin. What comparison is possible if ships like the "Asama" and "Chiyoda" are placed in the same category? Again, does the mere carrying of a thin water-line belt render the "Chiyoda" some classes better than, say, the "Takasago?"

Following these lines of thought, I have, in the following tables, flung the usual classifications overboard, going instead to something like the old rating system of the past. Owing to progress in offense and defense, it is not possible to get more than a loose equality in the rates; however, I have made my lists with regard to what they may prove.

Speaking generally, a first-rate ship has had to conform to most of the following conditions:—

(*a*) The vitals so protected that no projectile stands much chance of reaching them, even at close range.

(*b*) The main armament must consist of the most powerful armor-piercing guns. These must have central loading positions, and be generally not liable to be easily put out of action by small shell.

(*c*) The secondary armament must be well protected and powerful.

(*d*) The ship must generally be able to beat down the fire of a ship in a lower class.

In the tables following, ships of the same type are bracketed. A (B) to Russian ships signifies Black Sea Fleet. An * indicates that the ship has been re-armed more or less thoroughly, or is about to be. (M) Indicates muzzle-loading guns; (O) old type breech-loaders of no higher value than our muzzle-loading pieces. Ships not yet completed are put in italics.

It will be noted that the "Royal Sovereign" class are excluded from this list of first-rate ships. They are powerful vessels, but their secondary guns are poorly protected, while their big guns, loading end on as they do, form an immense target for small shell. It is hard to see how they could be fought in anything like close action. The "Canopus" class, weak on the water-line, may barely deserve inclusion, but their armament is good, and water-line bits are sure to be very rare. The "Bouvet" and "Massena" are very near the border line, and so are the Russian "Poltavas." The former, however, are better all-round ships than the "Royal Sovereigns"; while as to the "Poltavas," though these lack submerged tubes, though the protection to their big guns is far from ideal, their secondary armament is better placed and protected than in most other craft, and they seem generally to just merit inclusion—that is to say, they are a trifle better than the "Royal Sovereign" class, and better able to stand the gun fire which only the last year or so has rendered probable. Germany, it will be noted, has no ships of the first rate; excellent vessels through the "Kaiser Friedrich III." class may be in some ways, yet they have no guns capable of delivering vital blows, and their secondary armaments is terribly at the mercy of a big shell bursting beneath them. These two defects are held to disqualify them, though it must not be held too heavily to discount their value against first-raters. It will, however, be noted that many of the ships in the second rate are only slightly inferior to the preceding class.

In this list the "Charles Martel" and "Carnot" appear, because they have inferior armor and fewer minor guns than the "Bouvet." In German ships we find the so-called armored cruiser "Bismark." All the other Germans, like all the English and French and the greater number of the Russians, usually pass as first-class battleships. None, however, are first-rate; if modern built like the "Peresviet," "Renown," and "Rostislav," their big guns are not of the first rank;

The Rating of Warships.

First-rate Fighting Ships.

England.	France.	Germany.	Russia.
Majestic Magnificent Mars Illustrious Cæsar Hannibal Prince George Jupiter Victorious Canopus Ocean Glory Goliath *Albion* *Vengeance* *Formidable* *Irresistible* *Implacable* *London* *Bulwark* *Venerable* *Duncan* *Russell* *Exmouth* *Cornwallis* *Albemarle* *Montagu*	Charlemagne Gaulois St. Louis Bouvet Massena *Iena* *Suffren*		Poltava Petropavlovsk Sevastôpol Tri Sviititelia (B) *K. P. Tavritchesky* *Retvizan* *Tavritch* *Alexander III.*
13 + 14 building	5+2 building *		4 + 4 building

* The six new ships just projected are not included.

Second-rate Fighting Ships.

England.	France.	Germany.	Russia.
Royal Sovereign Repulse Resolution Revenge Ramillies Royal Oak Empress of India Hood Renown Nile Trafalgar Sanspareil *Drake* *King Alfred* *Leviathan* *Good Hope* (Africa) *Aboukir* *Cressy* *Eurgalus* *Bacchante* *Sutlej* *Hogue*	Charles Martel Carnot Brennus Jauréguiberry	Brandenburg Woerth K. Friedrich Wilhelm Weissenbourg K. Friedrich III. K. Wilhelm II. *K. Wilhelm der Grosse* *A* *B* *C* *D* *E* Bismark *New Bismark*	Peresviet *Oslabia* *Pobieda* *Orel* *Borodino* Geo. Pobiedonosets (B) Sinop Veliky *Rostislav (B)* Navarin D. Apostoloff (B) Sinop (B) Tchesma (B) Ekaterina II. (B) *New ship?*
12 + 10	4 + 0	7 + 7	8 + 6

Third-rate Fighting Ships.

England.	France.	Germany.	Russia.
Benbow Anson Camperdown Rodney Howe Inflexible (M) Colossus Edinburgh *Essex* *Kent* *Monmouth* *Bedford* Barfleur Centurion	Baudin Formidable Hoche Magenta Marceau Neptune *Henri IV.* Courbet* Dévastation* Redoutable* Bouvines Tréhouart Jémappes Valmy Dupuy de Lôme *Jeanne d'Arc* *Dupetit Thouars* *Gueydon (ars* *Montcalm* *Condé* *Gloire* *Sully* *Aube* *Marseillaise*	*Redoved Bismark (projected)*	Nikolai I. Alexander II. *Bayan* *Gromovoi*
10 + 4	14 + 10	0 + 1	2 + 2

Fourth-rate Fighting Ships.

England.	France.	Germany.	Russia.
Collingwood Imperieuse Warspite Aurora Australia Immortalité Galatea Narcissus Orlando Undaunted Ajax (M) Agamemnon (M) Alexandra* (M) Superb (M)* Téméraire (M) Neptune (M) Devastation* Thunderer* Dreadnought (M) Conqueror Hero Diadem Europa Powerful Terrible Andromeda Niobe Spartiate Amphitrite Argonaut Ariadne Crescent Royal Arthur Blake Blenheim St. George Gibraltar Edgar Endymion Grafton Hawke Theseus	Indomptable Requin Caiman Terrible Duperré (O) Pothuau Bruix Chanzy Charner LaTouche Tréville *Dupleix* *Desaix* *Kléber* D'Entrecasteaux Bayard (O) Turenne (O) Duquesclin (O) Vauban (O)	Baden (O) Baiern (O) Württemburg (O) Sachsen (O) Oldenburg (O) Siegfried Beowulf Frithjof Heimdall Hagen Hildebrand Odin Ægir	Oushakoff Seniavin Apraksin Rossia D. Donskoi Pamiat Azova V. Monomakh Nahimoff Rurik Peter Veliky*
42 + 0	15 + 4	13 + 0	10 + 0

Fifth-rate Fighting Ships.

England.	France.	Germany.	Russia.
Sultan (M) Hercules (M) Iron Duke (M) Swiftsure (M) Triumph (M) Audacious (M) Invincible (M) Monarch (M) Bellerophon* Hermes Highflyer Hyacinth Arrogant Furious Gladiator Vindictive Eclipse Minerva Talbot Diana Dido Isis Doris Venus Juno	Colbert Trident Richelieu Furieux Guichon ChateauRenault Tage* *Jurien d. l. Gravière* Protet Catinat Descartes Pascal Cassard d'Assas Du Chayla Bugeaud Chas. Laubat Friant Jean Bart* Alger* Isly* Suchet Davout Sfax* Cécille	Kaiser Deutschland König Wilhelm* Freya Hertha Vineta Hansa Victoria Luise Kaiserin Augusta	*Askold* *Variak* *Bogatyr* *Boyarin* Diana Pallada *Aurova* Korniloff* Minin Edinburgski General Admiral *New Ship*
25 + 0	24 + 1	9 + 0	6 + 6

Totals.

Rate.	England.	France.	Germany.	Russia.	Total, F., G., R.
	Bldg.	Bldg.	Bldg.	Bldg.	Bldg.
1st	13 + *14*	5 + *2*	0 + *0*	4 + *4*	9 + 6
2nd	12 + *10*	4 + *0*	7 + 7	8 + *6*	19 + 13
3rd	10 + *4*	14 + *10*	0 + *1*	2 + *2*	16 + 13
4th	42 + *0*	15 + *4*	13 + *0*	10 + *0*	38 + 4
5th	25 + *0*	24 + *1*	9 + *0*	6 + *6*	39 + 7
6th	53 + *0*	7 + *0*	2 + *0*	3 + *3*	12 + 3
7th	29 + *2*	11 + *0*	13 + *2*	4 + *0*	28 + 2
Total	184 + *30*	80 + *17*	44 + *10*	37 + *21*	161 + *48*

Sixth-rate Fighting Ships.

England.	France.	Germany.	Russia.
Astræa Bonaventure Cambrian Charybdis Flora Forte Fox Hermione Æolus Brilliant Intrepid Indefatigable Iphigenia Pique Rainbow Retribution Sirius Spartan Apollo Andromache Latona Melampus Naiad Sappho Scylla Sybille Terpsichore Thetis Tribune Forth Thames Mersey Severn Belleisle (M) Orion (M) Rupert* Hotspur (M) Glatton (M) Cyclops (M) Gorgon (M) Hecate* Hydra (M) Abyssinia Magdala Cerberus Agincourt Minotaur Achilles (M) Northumberland (M) Warrior (M) Black Prince (M) Nelson Northampton	Fulminant Tonnerre Tonnant Vengeur Tempête Onondaga* Friedland	Irene Prinzess Wilhelm	K. Pojarski Rynda Svietlana *Nogic* *New Ship* *New Ship*
53 + 0	7 + 0	2 + 0	3 + 3

Seventh-rate Fighting Ships.

England.	France.	Germany.	Russia.
Amphion Arethusa Leander Phæton *Pandora* Psyche *Pioneer* Pomone Pactolus Perseus Prometheus Pegasus Pyramus Pelorus Prosperine Pallas Pearl Philomel Phœbe Katoomba Mildura Ringarooma Tauranga Wallaroo Medea Medusa Marathon Magicienne Melpomene Scorpion Wivern	Achéron Cocyte Phlegeton Styx Flamme Grenade Mitraille Fusee Lavoisier Galilee Linois	Gefion Gazelle *Nymphe* *Another* Viper Wespe Biene Hummel Skorpion Mücke Camaeleon Basilisk Crocodil Natter Salamander	Khrabry Otvajny Grosiatschy Gremiatschy
29 + 2	11 + 0	13 + 2	4 + 0

while if, like the "Trafalgar" and "Brennus," they have powerful armor-piercing guns, they are outclassed by age or known defects. The "Drake" class of "armored cruiser" must be included. Krupp armor makes them far less liable to a vital blow than the battleships classed with them, while their Q.F. fire is far heavier. Compared with the "Kaiser Friedrich III.," they have one quick-firer less per broadside and two big guns less. On the other hand, the "Drakes" have five knots more speed, and their guns are infinitely better protected. Certainly they could be relied on to come out of a fleet action better than the German battleship, for they are not much more easy to hurt than the "Majestic;" the belts—thanks to Krupp armor having the same resisting power as the "Majestic's" 9-inch Harvey. Nothing under a 12-inch shot is likely to get through at ordinary fighting ranges of 2,000 or 3,000 yards.

Here, again, seven of the British, and six of the French, are often called first-class by courtesy, though any vessels of the second-rate ought to smash them easily. The balance of modern "armored cruisers," protected both on the water-line and at the guns, appear in this rank. Though their guns are of the second or third rank (B or C, to use the naval war game notation), yet their vitals are as well or better protected than those of the older ships classed with them, their preponderance in quick-firing guns well protected is great, and altogether speed gives them many chances. A duel between the "Essex" and the "Jémappes," or between the "Jeanne d'Arc" and the "Benbow," would be quite an uncertain affair; but the odds, if anything, are in favor of the armored cruisers. This—allowing speed its tactical value—the speed of a ship, as regards her ability to run away, and so forth, has nothing to do with this classification.

The "Collingwood," it will be noticed, has been shifted into a lower rate than the other Admirals. Her big guns are not by any means equal to those of her sisters. She is in fighting quality no better than the "Colossus," while in defense she is much inferior. The latter has her quick-firers more distributed, and her main armament is better protected. Ships like the "Diadem," with unprotected water-lines, are here, by virtue of their superior and better protected quick-firing armament, classed with the "Aurora," or the "Essex," whose thin armor conveys less protection than to the "Cressys." As before, any of the ships in this category might be put "in line" against each other without its being possible to forecast the result. The cruisers in this fourth rate are those generally known as "first-class," except the German ones, which have casemates, and are generally superior to ships in the fifth rate, though second-class cruiser is their usual name.

This fifth rate contains such of the older ironclads as have some small fighting value, and the better "second-class cruisers," which may be held a match for them. It will be noted that the French, ship for ship, equal the British; while in the class just below it is a case of this country first and the rest nowhere. The dividing line between the fifth and following rate may appear at first sight somewhat thin—the ships, however, have all been placed by careful calculation. Thus, the French cruisers generally carry four or more 16-centimeter guns, with a balance of 10-centimeter against our two 6-inch and a balance of 4·7-inch and 3-inch. Now, a 16-centimeter gun is about equal to three 4·7-inch, and three 10-centimeter equal one 6-inch or two 4·7-inch. The bigger shell is so much more powerful. We can arrive at some reckoning of value for comparative purposes on this system by reducing all guns to a common denomination. "Energy of fire" is useless, as that implies penetration; cruisers are concerned with the bursting power of shells. In naval Kriegspiel notation ten minutes fire of any guns in classes A to D is taken to do the same amount of damage against unarmored structures. Below D (the 6-inch quick-firer) the notation halves itself, i. e., two E (4·7) or four F (3-inch) are required to do the damage done by one 6-inch. Approximately this is correct. Assuming it now, we get.

One 6·3 (15 centimeter)	= three 4·7-inch	= 6 F (3-inch).
One 6-inch	= two "	= 4 "
One 4·7-inch		= 2 "
One 4-inch (10-centimeter)	= ½ of a 6-inch	= 1½ "

Working things out on this principle, with the 3-in. gun as the common denominator, we find;

	Guns.	Equivalent value in 3-in. quick-firing pieces. Total guns.	Best broadside.
"Highflyer"	Eleven 6-in., eight 3-in.	= 52	28
"Eclipse"	Five 6-in., six 4·7-in., eight 3-in.	= 40	22
"Descartes"	Four 16 cm., ten 10 cm.	= 37½	18½
"Arrogant"	Four 6-in., six 4·7-in., eight 3-in.	= 36	22
"Friant"	six 16 cm., four 10 cm.	= 41½	—
"Irene"	Four 6-in., eight 4-in.	= 24	12
"Svietlana"	Six 6-in.	= 24	12
"Hermione"	Two 6-in., eight 4·7-in.	= 24	16
"Apollo"	Two 6-in., six 4·7-in.	= 20	14

The distinguishing line between the "Eclipse" and "Hermione" classes here come out very clearly.

As a matter of interest we may mention that the shell fire of the "Majestic" works out to a total of 80 on this system, and the "Kaiser Friedrich III." at 104, with broadsides of 48 and 60 respectively. The question of armor-piercing is, however, bound to enter, so the system is of limited value outside protected cruisers. Putting speed and armor out of the question, this method suggests the old ratings of 80-gun ships, 74's, etc.; and for calculating a cruiser's chances against a battleship may be fairly sound.

The sixth rate brings us to the Admiralty's pet "armored cruisers." It demands little attention, nor does the seventh rate immediately following, which carries us to the bottom of the list of ships with much fighting value. The ships in the eighth rate are merely glorified torpedo cruisers, their protection too slight to be worth consideration. They belong more, or less, to the genre of the Spanish ships that sank in the Cavite fight. Rate seven are many of them of doubtful value; the swift ones would be used as scouts, the slow for coast defence purposes, and hence demand mention.

Now for results, which we have noticed as we proceeded, although some were unsuspected at the beginning.

The totals are given at bottom of the middle column, page 20296.

Looking into this, we find a reassuring enough grand total, but only the first four rates can be held to be of much fighting utility, and of these the fourth is, perhaps, to be discounted.

Let us review this total thus:

Rate.	England. Bldg.	France and Russia. Bldg.	France, Russia and Germany. Bldg.
1st	13 + 14	9 + 6	9 + 6
2d	12 + 10	12 + 6	19 + 13
3d	10 + 4	15 + 12	16 + 13
4th	42 + 0	25 + 4	38 + 4
Total	77 + 28	62 + 28	82 + 36

Here our total superiority to the two powers is tolerable; against the three we are in a minority of 5, which, in a year or two, will be 13.

Battle squadrons will be drawn from the first two rates only, so far as possible, and third-rates ships, if used, will be as stop-gaps. In these battle ranks we find that the totals are:—

Rate.	England. Bldg.	France and Russia. Bldg.	The Three. Bldg.
1st	13 + 14	9 + 6	9 + 6
2d	12 + 10	12 + 6	19 + 13
Total	25 + 24 against	21 + 12	or 28 + 18

—showing us superior to France and Russia by four ships, inferior by three to the three Powers, but superior by three in a couple of years. Some Russian ships are, of course, too, shut away in the Black Sea, but they would never stay there were a combination against us, so must be reckoned.

Thus far numbers. There remains the question of a common denomination. Roughly, four first-rates may be considered equal to five second-rates. This would make the figures:—

	England. Bldg.	France and Russia. Bldg.	The Three. Bldg.
Equivalent in first-rates	22·6 + 20	18·6 + 10·8	24·2 + 16·2
Total, future	42·6	29·4	40·4

No very brilliant prospect for France and Russia.

For those who care to pursue the subject further, I may add that the values of the rates may be roughly calculated as follows:—

I. = 10, II. = 8, III. = 6, IV. = 4, V. = 3, VI. = 2, VII. = 1.

By this:

	British Empire. Building.	The Three. Building.
1st rate, × 10	130 + 140	90 + 60
2d " × 8	96 + 90	152 + 104
3d " × 6	60 + 24	96 + 78
4th " × 4	168 + 0	152 + 16
5th " × 3	75 + 0	117 + 21
6th " × 2	106 + 0	24 + 6
7th " × 1	29 + 2	28 + 2
	664 + 256	659 + 285
Future totals	920	944

Which means that upon a general denomination system we are not superior in the future, though at present we are.

I have not considered it necessary to tabulate out other navies. I may, however, mention that at present Russia stands at 184 with 124 building, Japan at 72—including the "Shikishima"—and 78 building. The totals for the future being:—

Russia	312
Japan	150

I had not expected to find the Russian fleet at so high a figure till I made my calculations. Of course, Russia has fifty-eight points shut up in the Black Sea, but apart from that, it is a matter of note that she has building ships nearly totaling to the entire navy of Japan—three more "Peresviets" would do it.

The value of these calculations stands to be discounted by two things, personnel, which cannot be allowed for; and, secondly, errors in classification or in the ratios of value between the rates. However, this matter of rating and values has been carefully worked out by the naval war game, which is purely a matter of material, and so far as any certainty in such a problematical subject can be arrived at, efforts have been made to reach it. In any case the figures represent the result of a year's labor at ascertaining them; and if those of my readers who are interested in the question, and in a position to deal with it, would favor me with their criticisms, some substantial progress would be made toward elucidating a very vexed question. Classification as it exists is obviously useless; but a rational general system must be within the realm of possibility.

It must be borne in mind that this system of rating is a different thing to classifying. Classifying puts—or ought to put—together ships that are more or less equal in the same tactical qualities, it does not class them with a view to their comparison. The fact of one ship being a "first-class cruiser," another an "armored cruiser," another a "second-class battleship," does not primarily create any conditions of comparison between them. But it has come to be taken as doing so, and some very erroneous ideas as to the value of "fighting lines" have come to be rather general in consequence. Perhaps a commonplace illustration will make the situation clearer. Let us take cricket; one player shines at batting, another at bowling, another is a good all-round fielder, and so on. Bowlers can be classed, batsmen can be classed, but the fact of being in either one or the other class does not gage or rate a man's position all-round. Good bowlers are needed, excellent bats are needed—sometimes a good bowler and bad bat may be a greater acquisition to a team than a better batsman but worse bowler—or the reverse may obtain. So it was with the various classes of ships. But just as an all-round estimate may be formed of a cricketer, his batting of such and such value, his bowling of so much and so on—so, too, something of the sort may be arrived at with ships.

The anology must be pushed too far, but the underlying principle in this rating is the same. But we are rather more limited, at first sight, at any rate, because coal endurance plays a small part in the rating. It must be borne in mind that the idea has been to get only a fighting value. Given equal personnel, an action between any two ships of the same rate should be impossible to forecast with certainty, while if the rates differ the result should be certain. In the lower rates some of the peers may appear startling—the "Inflexible" and "Dupuy de Lôme," for instance. Yet though the former, if she hit, would demolish the latter, yet the "Dupuy" could do the same thing by a shell fire beyond range of the "Inflexible's" big guns. Ability to ram or to torpedo should be hers alone. Each runs grave risks from the other. Again, the "Tonnant" and "Astræa" are rated together. It is hardly likely that they would meet in war in a fleet action, if they did the total fighting value of them to their fleets may be called the same. The speed and quick-fire lacked by the one is met by the lack of protection on the part of the other. One is nearly all defense, the other nearly all offense. Nothing is clearly known as yet as to which, in the absence of both offense and defense combined, is best. There must be individual theories. In this rating we steer clear of theories.—Engineer.

THE WARFARE OF THE FUTURE.

THE war in South Africa has been watched with eager interest by military men all over the world. It has been the first opportunity of testing modern weapons and modern tactics in land fighting on a scale large enough to clear up the mists of theory and enable new bearings to be taken, which are so much needed to guide the gigantic war preparations going on in every civilized country.

Mr. I. S. Bloch, whose published theories are said to have influenced the Czar in calling the Peace Conference, predicted in a general way, some of the events of the Anglo-Boer war, as natural results of the clash of modern arms. His predictions, however, that war by modern methods is impossible, due to its increased deadly character, has hardly been borne out by the events of this war.

Mr. Hudson Maxim, the well-known inventor, in a most interesting and timely article in The Home Magazine for April, takes an opposite view from that of Mr. Bloch, and presents some very strong reasons supported by facts to show that war is not only now possible, but that the very deadliest of the weapons employed lessens, instead of increasing, the actual casualties.

Mr. Maxim explains, and graphically represents by diagrams how, as the effectiveness and range of weapons are increased, the area over which armies fight is increased in proportion, and that with the doubling of range and efficiency, the size of the battlefield are increased about fourfold, while the casualties are decreased in about the same ratio. His reasoning appears to be well borne out by history.

Mr. Maxim says:

"When armies fought with swords, spears and battle axes, the attack was in the open, and usually on level ground. It was not then infrequent that half the numbers engaged were killed. One hundred thousand Persians fell in a day before Alexander. Hannibal slew at Cannae (B. C. 216) 48,000 Romans, out of 60,000. In the great battle in the Valley of the Marne, October, A. D. 451, between the combined Romans and Goths, and the Huns under Attila, the allies slew the invading barbarians at the rate of 100,000 a day for three days. That was the bloodiest battle in history. That bloody job stands pre-eminent in history as an instance of justifiable homicide. It saved Europe from savagery and rescued civilization.

"It is estimated that Cæsar's wars cost more than 2,000,000 lives. His war bulletins did not report a long list of wounded and a short list of slain. They were death lists—so many killed. The number of wounded was insignificant.

"Why was it that such large numbers were slain, and with such primitive weapons? It was for the very reason that the weapons were primitive, and required the combatants to come to close quarters, and to fight practically hand to hand. To be defeated then was to be annihilated. There were no means for covering retreat. When the battle began to turn, the enemy was already at the heels of the vanquished, and in a position to cut them down without mercy, while yet frenzied in the fury of the fight.

"It was a saying of Napoleon that in war, as in love, to conclude matters, it is necessary to come to close quarters.

"In pace with improvements in weapons, we find the number of casualties diminished. After the introduction of firearms they were for a long time so primitive in form, and the powder so poor, that it was necessary to come within close range in order to hit anything or to make the shooting effective, and there was still much hand to hand fighting with bayonets, spears, and swords.

"In the great battles of the Napoleonic wars, the numbers slain for the men engaged, though great, were far less than in the great battles of pre-gunpowder times.

"In our great war of the Rebellion, the determined character and fierce fighting qualities of both Federals and Confederates were responsible for some high percentages of the slain, notwithstanding the considerable improvement in arms and ammunition since Napoleon's time, in whose battles the participants were far less evenly matched than at Shiloh, Antietam, Gettysburg, and the Wilderness. At Borodino, however, when Bonaparte threw his masses of trained veterans, the flower of France, upon the stubborn, unflinching Russians and fierce Cossacks, it was the bloodiest battle ever fought with gunpowder, 82,000 being left killed and wounded upon the field—52,000 Russians and 30,000 Frenchmen. In a battle fought by modern methods, with all the latest improvements in implements of destruction, between combatants in numbers equal to those engaged at Borodino, and of similar fighting qualities, the casualties would not be more than a third as great, while the percentage of recoveries of the wounded would be enormously increased."

In answer to the claims made by Mr. Bloch as to the evil effects of war, and which are voiced by peace parties everywhere, Mr. Maxim states:—

"Grim death is necessary to life on earth. Hunger and cold, disease and famine, are necessary and desirable accompaniments of war, for the greatest good to the greatest number of the fitter specimens who survive, and to balance the loss of the fine types of men slain in battle. The stay-at-home incompetents and imbeciles perished by thousands during old wars of Germany. It is said that the wars of Napoleon shortened the statue of the modern Frenchman by two inches. Strange is destiny. 'The mills of God grind

slow, but grind exceeding fine.' The plunder of surrounding nations by Napoleon caused thousands of the weak and imbecile to perish in those countries. This same plunder fed, fattened, and retained in society, to produce themselves, a similar class in France, who should have likewise perished for the good of the nation, to balance the loss of the flower of France who were killed."

In conclusion, Mr. Maxim describes some very novel and interesting inventions of his own, which he believes, when adopted, will have a revolutionary influence in warfare on both sea and land. He proposes dynamite trenches, a steam driven machine, which will run along the line of battle, planting dynamite charges in the earth and exploding them as it passes, leaving behind a deep trench for the reception of the troops as they advance. He also proposes smoke-producing bombs to be thrown in front of the enemy's position to shut off his vision, and allow the attacking party to advance unseen. He suggests a torch bomb for lighting up the entrenchments of the enemy at night, and explains how large bombs could be made for throwing sulphuric anhydride, into the works of the enemy, for disintrenching him by the burning, choking fumes of sulphuric acid, which would be evolved, and which would force him to beat a hasty retreat with small loss of life and with few serious wounds.

Mr. Maxim also describes a new invention of his which he terms "a battleship destroyer," being a form of torpedo boat participating in the features of both the submarine and the above water boat. All of the vital parts of the boat are placed deep below water when in action, and a dispensable superstructure filled with cellulose or a similar material, and for flotation purposes only, projects from a foot to two feet of water, thus suspending the torpedo boat from the surface. Shot and shell from the batteries of the enemy could, at most, but tear away a portion of the superstructure, without inflicting any real injury to the craft, while the latter could advance upon a battleship to eject its automobile torpedoes in rapid succession, while guns for throwing with great rapidity, large aerial torpedoes, carrying 500 pounds of high explosive, are proposed.

A very startling innovation is proposed by M. Maxim for the propulsion of this torpedo boat when in action, ordinary means of propulsion being employed at other times.

He explains how, by the combustion of a material similar to the smokeless powder, water may be evaporated and the mixed steam and gases of the burning material used to drive turbines. By this means a boat like that which he describes could, in an emergency, be supplied with 15,000 horse power for two hours, in addition to her normal horse power derived from another source; or, 30,000 horse power for an hour, 60,000 horse power for half an hour, or 120,000 horse power for fifteen minutes. He proposes to drive automobile torpedoes by the same means, instead of with compressed air which is now employed.

He has determined by experiments already concluded that the combustion of the material may be controlled and the energy utilized in the above manner.

THE BIRD-STONE CEREMONIAL.*

IT is with some apprehension that I begin the description of a class of objects regarding which most archæologists are silent. But some one must assume the initiative. Recently, while reading the excellent reports prepared for the State of New York by my friend, Rev. William Beauchamp, I noted with pleasure that he devoted some pages to the "bird-stone" ceremonial, I investigated the subject and aside from a somewhat lengthy account by Professor David Boyle, of the Canadian Museum, and shorter references on the part of Messrs. Wilson, Douglass, Fowke, Abbott, Gilman, Cushing, Jones and a few others; found that the subject has been ignored.

The undefined class of prehistoric ornaments or charms which we have been calling "ceremonials," represents stone age art of no mean degree. Not only are these slate and granite objects of such finish and polish as to stamp them as something beyond the ordinary, but their graceful forms commend them alike to the museum and the collector.

Even persons having no archæologic inclinations are able to appreciate their beauty and workmanship. Admiration of fine paintings is not confined to art critics, for any person with an eye to the beautiful or to color effect can enjoy and understand them. So it is with bird-stones, and the person of education or culture who may see nothing attractive in the ruder flint or stone tools—and to whom they mean simply "relics" of savagery—need but examine a few of the figures herein set forth to find something well worth his consideration. To such I recommend the study of prehistoric American art.

The study of these objects must be confined to the specimens themselves. There is scant information as to their having been worn by the tribes and I am unable to find a record of their discovery at the heads of skeletons or in any of the tumuli or graves. There is this exception, that a somewhat different form was found in the altar of Effigy Mound, Hopewell Group, by the World's Columbian Exposition Survey. But this shed no light upon the bird or "saddle" form proper. Many hundreds of the choicest posessions of the Hopewell people were cast into the altars upon the sacrificial fire. Even had we found the true bird-stone ceremonial along with the copper, obsidans and effigies, it could have but one interpretation: that this form was made and used by the Hopewell people.†

We will first consider the four or five variations: Fig. 1 stands for a type which I select as representative or distinctive. None of the bird-stones are common in the sense that stone axes are common. They bear the same relation to the art of prehistoric times that real gems do to the common or cheap jewelry of to-day. Fig. 2 represents a very small form. Let us here observe that but few of there stones are found damaged or broken. They may be rough, or fine, yet 80 per cent. of them are perfect, or nearly perfect; whereas the banner, or butterfly, and the tablet of unusual size, or the perforated ceremonial of pick or crescent shape, is frequently broken or damaged. Less than one-half of such specimens are entire. Fig. 1 which is nearly as delicate as other ceremonials, seems to me to mean more than that it has withstood freezing, the plow, passing of heavy animals and other destructive agencies which have conspired to destroy the pick, banner, crescent and tablet like forms. Possibly in wars, or raids, the victors purposely broke certain objects and spared others. Why? I know not. Be this as it may the fact remains that bird-stones are usually preserved, and is testified to by many collections whether large or small.

Fig. 1 is from DeKalb County, Indiana, and is in Mr. Gruhlke's collection.

Fig. 1 is found in the Eastern and Central States north of the Ohio River. It is very rare in the Potomac, Connecticut and Hudson Valleys and the Eastern

FIG. 1.—Northern Indiana. Gruhlke Collection. S. ½. Material, light blue slate.

FIG. 2.—Western New York. New York State Museum Collection. S. ½.

(northern) Alleghany region. But it is often found in Western New York, the Ohio Valley, the Great Lakes region and Central Canada.

Inquiries sent to archæologists in Iowa, Illinois, Missouri, Kentucky, etc., fail to establish its habitat as south or west of Indiana. Dr. J. F. Snyder, the well-known authority, reported that he considers it as confined to the Northern and Eastern United States. I fail to find anything like it in form in the archæologic reports on Europe, Central and South America or the Pacific Coast.

Fig. 3 is from Southern Ohio, and of the banded slate so frequently employed in the manufacture of these specimens. It is rather unusual in form, having the square (or slightly rounded) bill (or mouth), and disks sunk to represent the eyes. The object was in my collection in 1889, but just what disposition I made of it I do not now recall.

Fig. 4 is remarkable in that it is so large. It is from Michigan and is shown full size. This specimen may not be a "bird" but as to that let other and more competent observers decide. As will be seen by the shading, it is of banded slate and well worked. Obviously it is too large and heavy for a head ornament. The perforation is forward and at the side. This is very

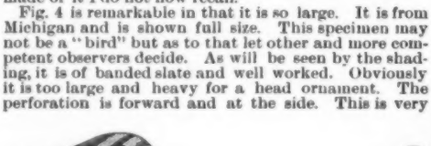

FIG. 3.—Southern Ohio. S. ½.

FIG. 4.—Southern Michigan. S. ½.

unusual, and marks a departure from the prevailing custom of placing the holes at the ends and in the base.

Students should first observe the care and skill with which these objects are made. There are unfinished specimens of most of the several classes of ceremonials, but of the bird-stone I never saw but five or six which gave a clue to the method of manufacture.

The range of material is not broad. It is almost entirely confined to banded slate or harder shales. Prof. Emery's eleven specimens cover a wide territory, yet they are all of Huronian slate or shale. Objects like Fig. 3 are usually of porphyry or granite,* and occasionally of porphyritic felspar; in short, they are of stones of mottled or showy colors, preferably, red, gray, white or brown. The illustrations in this bulletin of types, like Fig. 2, show the blotches or shades of the stone. Fig. 1 is sometimes found of plain black slate or dark blue, with very minute bands, or bands so small that the specimen appears very compact and without variation in color, but as I have said, bits of slate and shale were selected which showed variegated colors, and as the specimen approached completion these shades or bands were brought out conspicuously by careful and persistent polish.

The making of any one of these ceremonial ornaments was no boy's play, and required a great deal of time. I take exceptions to the remarks of some observers, that most stone objects could be brought to perfection in a few hours.

Having selected a suitable stone, it was held in the left hand and pecked and hammered with a small hammer stone such as are common all over the United States and usually of a harder material than the object to be worked.† Having been given a rough outline of the desired shape it was further hammered or pecked with a smaller hand hammer stone and somewhat more reduced. There was now danger of breaking by hammering and the specimen was ground, or rubbed and scraped with bits of sand stone, flint, or very rough pebbles until it is assumed more nearly the desired form. We have no positive information as to how it was completed, but guided by our knowledge of the manufacture of other implements it is safe to assume that this was, the process. The rubbing, cutting and scraping must needs be very carefully applied toward the completion of the object. Doubtless the final rubbing and polishing and finishing touches were given with wood and lastly with buckskin. This latter would give gloss and finish to the specimen. Perforations at each end of the object may have been drilled just before it was completed or reserved until the last. That we do not know. Sometimes these perforations broke during the process of making, or they may have broken while in use subsequently. Quite a number of bird-stones show a second perforation from the corner or end.

Materials of which they are made need not have been carried any great distance and we usually find them made of stone occurring in the locality. However, finished objects may have been transported to the tribes who did not live in the region where shale or slate could be obtained. This was only in rare instances, as I am informed that shales and slates are very widely distributed.

Now, as to the thick or short specimens, such as Fig. 2, and several in Prof. Emery's exhibit, some of these are unfinished specimens and ready to be worked and perforated. Others are doubtless completed. Some were left in this form for convenience in trade (there being less danger of breakage) or, possibly, made by less skilled artisans in imitation of the more beautiful specimens and were worn by being tied by thongs over the back of the objects rather than through the perforations; for in many short and thick bird-stones there are no perforations.

Sometimes these specimens show restoration to usefulness by being redrilled.

In many the back is very sharp or angular, others are rounded. The object is flat under the head and neck and down the breast in types like Fig. 1.

The shortest (well-formed) bird-stone I have observed is two inches long. The average is three and one-half to four inches. Ones exceeding seven inches are rare and nine inches or more are very rare. The height is from two-thirds to one and a half inches, with an average of one inch. While a general similarity of form is seen, the proportions vary. In one the head is longer, or the body than in another. Short, thick heads and heavy short bodies naturally go together While the proportions may not be true yet the specimens generally appear graceful and pleasing to the eye.

While a series may be arranged in any large museum beginning with the most pronounced bird-stones and ending in a straight bar, yet the line of demarkation is not difficult of establishment. I would not include in the bird-stone class specimens in which the "head" is not clearly defined. If the ends be alike (slight ridges) and the body long and slender, the specimen should be classed as a "bar amulet".*

FIG. 5.—Dexter, N. Y. New York State Museum Collection. S. ½.

In bird-stones the perforations vary in size, usually being from one-third to one-fourth of an inch in diameter, wider at the opening (or exterior) and narrow (or smaller) at their point of union. They seem to have been made with flint pointed drills. The reed or wooden perforators made a more even hole.

The Figs. 6 and 7 really represent birds more than the saddle-shaped ones presented in many figures, and it must be remembered that there is a marked difference between the bird and saddle forms.

Two remarkable bird-stones, are in the Smithsonian collection. One, No. 58,552, Fig. 10, only that the eyes (or ears) are smaller. The tail is not elevated and there

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* by Warren King Moorehead, published by the author, at Saranac Lake, N. Y.

† It is largely by reasoning and comparison that we learn regarding the use of these artifacts, and readers must bear with me if the matter becomes a little tedious.

* They have been found made of feldspatic granite or diorite.

† In the American Anthropologist, Smithsonian and Bureau of Ethnology reports, and Archæologist, are numerous papers by Prof. Holmes, Mr. McGuire, Prof. Cushing, Dr. Wilson, and others, on stone working. The list of titles is too long to be given here.

* This term is meaningless and emphasizes the need of an archæologic nomenclature.

are two sets of perforations. The back is high and sharp. It was found in Broome Co., N. Y. It is about 2⅝ inches long and 1⅝ inches high. Material, diorite.

No. 139,532 of the Smithsonian collection is shown in my Fig. 13, full size. Found in Michigan, by Mr. C. A. Thomson. Material, diorite with large feldspar crytals.

It has the bird head and small eyes, but its body is low and the tail is not elevated. It is broad, doubly perforated and somewhat turtle-like in form.

An occasional bird-stone has but one set of perforations and they are in the forward end. These, as well as shorter and heavier ones, could not be securely fastened without some trouble. Were they intended for wearing on the head? If there is merit in the theory that bird-stones were kept by the shaman in his "sacred lodge," ought not it to be confined to the short ones such as Fig. 9.

The Wisconsin specimens are rather peculiar.

Dr. Beauchamp in the Bulletin of the New York State Museum,* gives a very good description of some fifteen bird-stones, I quote at length from his paper:

"The theories about their use seems fanciful, as some certainly are. Two writers assert that they were worn by married or pregnant women only, and many

FIG. 6.—Dresden, N. Y. New York State Museum Collection. S. ½.

have accepted this statement. Others think they were worn by conjurers, or fixed on the prows of canoes. It is enough to say that some of the perforations are not adapted to any of these uses. It seems better to class them with the war and prey or hunting gods of the Zunis, some of which they resemble. In that case the holes, of whatever kind, would have given a firm hold on the thongs which bound the arrows to the amulet, a matter of importance in an irregular figure.

"These perforations form the most important feature. The amulet may be but a simple bar, but at each end of the base is a sloping hole, bored from the end and base and meeting. To this necessary feature may be added a simple head or tail, and there also may be projecting ears. None of these are essential. They are but appropriate or tasteful accessories.

"Two notable collections contain a large number of amulets. In the Canadian collection at Toronto there are about 50 bird amulets.

. . . . . .

(He mentions Mr. Douglass' 70 specimens and also refers to the rarity of bar amulets in Western New York.)

"They were variable in material as well as form, although most commonly made of striped slate. Perhaps, full half have projecting ears, when of the bird form. In the wider forms, usually of harder materials, there are often cross bars on the under side, in which the perforations are made. Occasionally these are not

FIG. 7.—S. ½.

Side View Fig. 7.

FIG. 8.

All from Western New York. New York State Museum Collection. S. ½.

entirely enclosed, yet are without signs of breakage. This seems to prove that these was not intended as means of attaching them to any larger object, on which they would rest, but rather for fastening articles upon them, as in the Zuni amulets already mentioned, and which was illustrated by Mr. Frank H. Cushing, in the second Report of the Bureau of Ethnology. On comparison a general resemblance to these will be seen, and in a few cases it is quite striking. That there were used in this way, rather than in those suggested by others, is a reasonable conclusion which gains strength with fuller study. As a class they belong to the St. Lawrence basin.

. . . . . .

"Fig. 5 is a remarkably fine bird amulet of green striped slate,* the longest we have seen from New York, but reduced in the illustration. It is 9⅞ inches from tip to tip, and of moderate height and thickness. It was found at Dexter, near the mouth of the Black River, and although in three pieces, was not otherwise defaced. The black is sharp, and it has projecting ears and a long neck. The head ends squarely. Another, from the same county, is also large, being 8⅝ inches long by 2 high. It has no projecting ears.

"Fig. 6 is from Dresden, on Seneca Lake, and is of green striped slate. The ears are usually small. It is a fine article, and is 3½ inches long by 1⅛ inches high.

FIG. 9.—S. ½.

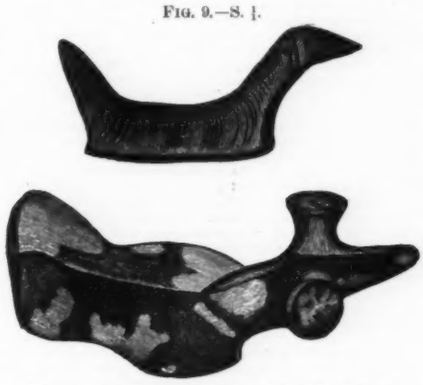

FIG. 10.—Seneca River, N. Y. New York State Museum Collection. S. ½.

"Fig. 2 is also of green striped slate, from the Seneca River, and is 3¼ inches in length. There are no ears, but along the edges are 91 notches.

"Fig. 7 is a broad form of mottled stone, 3⅜ long by 1¾ inches high. It comes from Newark Valley, Tioga County. There are small projecting ears and the tail comes to a point, as in some others of this general form and material. Two views are given of it. This form is highly polished, and the basal perforations are not always completely enclosed. They have also as a rule, a slight transverse ridge, in which the perforations are made.

"Fig. 9 comes from near the Seneca River. . . . .

"Fig. 10 is a very curious and fine bird amulet from the Seneca River, 4½ inches long by 1¾ wide, made of a mottled dark stone, gray and yellow, hard and highly polished. The ears project to an unusual extent, and the forward perforation is not entirely closed. It closely resembles one from Grand Rapids, Michigan, in form and material, but has a more expanded tail. In fact it may be considered the finest example of this class of amulets yet found."

Dr. Beauchamp has had unusual advantages for the study of bird-stones. He observes in one specimen of brown slate: "which is broken, has a lateral perforation, a frequent feature for a secondary use of ornamental stones, allowing them to be suspended as

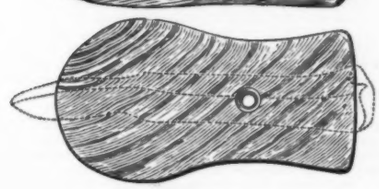

FIG. 11.—S. ½.

FIG. 12.—S. ½.

From Drawings by Prof. Cushing.

decorations. The edges are also notched; a frequent feature of amulets, perhaps as a record." He notes notched ears, also grooved ears or eyes in some of them. One water worn bird-stone from the beach of Cayuga Lake had a groove across the base. He thinks bar amulets were all used the same way. While not especially ornamental they have been "used as the Zuni amulets were," he said.

Mr. Gerard Fowke and Prof. David Boyle should be quoted upon this subject. Mr. Fowke says:*

"Stone relics of birds form are quite common north of the Ohio River, but are exceedingly rare south of that stream. (He illustrates the same specimen figured by Dr. Wilson.)

"According to Gilman,† the bird-shaped stones were worn on the head by the Indian women, but only after marriage. Abbot‡ quotes Col. Charles Whittlesey to the effect that they were worn by Indian women to denote pregnancy, and from William Penn that when the squaws were ready to marry they wore something on their heads to indicate the fact.

"Jones‖ quotes from De Bry that the conjurers among the Virginia Indians wore a small blackbird above one of their ears as a badge of office."

Prof. Boyle says:§ "Although for convenience known as 'bird-amulets'—most of them being apparently highly conventionalized bird forms—now and again one sees specimens that are not suggestive of birds, whatever else they may have been intended to symbolize. In some instances there has not been any attempt to imitate eyes even by means of a depression, but in the majority of cases the eyes are enormously exaggerated, and stand out like buttons on a short stock, fully half an inch beyond the side of the head. In every finished specimen the hole is bored diagonally through the middle of each end of the base, upward and downward. If merely for suspension while being carried, one hole would be sufficient, but the probability is that these were intended for fastening the 'amulets' to some other object, but what, or for what purpose is not known. It has been suggested that these articles . . . were employed in playing a game; that they are totems of tribes or clans; and that they were talismans in some way connected with the hunt for water fowl. They are, at all events, among the most curious and highly finished specimens of Indian handicraft in stone found in this part of America, and the collection of them in the Provincial Museum is said to be the best that has been made."

Prof. Boyle speaks of the bar amulet after treating of bird-stones, but he does not class them as the same kind of ceremonials.

The aborigine was a superstitious creature and as superstition begets much ceremony something had to be contrived to be of help in their religious or other rites. This bird or saddle-stone then had attributed to it a certain occult power and became a ceremonial weapon, and in instances of this kind had its position in the ceremony.

"So also do I think were used in the various rites

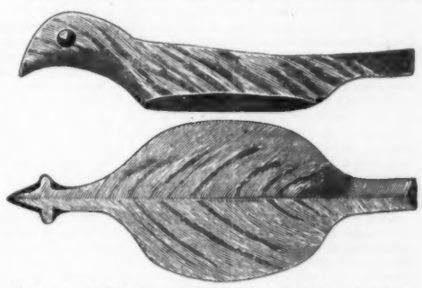

FIG. 13.—Michigan. Smithsonian Collection. S. ½.

the banner-stone, gorget and other nicely wrought objects. The addition of perforations perhaps made the meaning of the implements in the rites in which they were used more suggestive."

While the first half of this bulletin was being printed I received from Prof. Cushing several prints of plates he is to use in a memoir (shortly to be published) upon "The Calumet, etc., etc." The illustrations received cover the bar amulet and bird-stone types. Prof. Cushing has kindly permitted me to reproduce two of the figures.

It is interesting to note that we have reached similar conclusions independently. Neither of us was aware that the other was at work upon the subject of bird-stones, and, indeed, that class is only one of the many forms of ornaments considered by Prof. Cushing in his memoir.

I have not thought that the flat slate ornaments (perforated) or tablets were exclusively worn suspended, but on the contrary believe that many of them served as bases for little effigies or ceremonial objects. Prof. Cushing's Figs. 11 and 12 clear up much of the mystery as to the mounting of bird-stones. Still, it must not be presumed that all bird-stones were mounted in this manner. Nor is it apparent how tablets or ornaments (flat) having but one perforation were convenient for this purpose. To me the double perforated (two holes close together, near the ends of the tablet) ornaments would be better suited to serve as bases.

However, this is a matter of perforations merely and need not affect Prof. Cushing's theory. I entirely agree with him.

Now and then we observe a bird-stone in which the holes are worn as by a string and, apparently, the object has seen long service. The wearing is in the edges toward the head and tail of the bird (never at the sides), as if the cord were tightly drawn and the specimen permitted to but slightly move forward and backward. Many bird-stones show no marks of wear and in others the lower rims of the holes are but slightly worn.

Let us now theorize a little. One authority (De Bry), says that the shamen wore blackbirds over the ear, but he does not say bird-stones. The effigies may have been of wood or the skins of small birds. Medicine men of western tribes wore these latter in historic times. We can reconcile the statements that "women wore bird-stones after marriage" with "women wore

* Polished Stone Articles used by the New York Aboriginies, p. 60. Albany, 1897.

* I have changed Dr. Beauchamp's numbers of figures to correspond with my series.

* Stone Art, Bureau of Ethnology Report for '91-2, page 125.

† Gilman, G., in Smithsonian Report for 1873, page 371.

‡ Primitive Industry, page 371.

‖ Antiquities of the Southern Indians, page 30.

§ Notes on Primitive Man in Ontario, by David Boyle, Curator of the Archæological Museum for the Dominion of Canada. Toronto, 1896, page 67.

them to denote marriageable age." But can it be that the same type of effigy was used by both shamen and women? May not the statement mean, rather, that certain tribes used them for one purpose and another tribe used them for a totally different purpose? There are exceptions to every rule, but I have always understood that larger objects than these bird ceremonials were included in the "make-up" of a priest's headgear. Certainly skins, feathers, bones, wood, or horns formed most of it, and these were all objects of some size and when grouped together made a considerable mass. I should think that a bird-stone would not be noticed among these, or that it must needs be mounted separately or surrounded by smaller things; otherwise it would not be seen.

Reasoning from the facts presented, an observer would establish as his first proposition that these objects were tied in upright positions. He would judge that the objects were to be in relief and prominent; not concealed in any way; otherwise perforations were not necessary, as cords could be passed around the body near the head and tail and the bird-stone thus secured.

As a second proposition the observer might conclude that he considers some bird-stones as most nearly approaching the brooding bird, and were worn by women and indicating either marriage or pregnancy. But others, notably the short ones, and those with single perforations only, he might classify as medicine or charm-stones having a certain relation to the shamen; as tied to arrows or other personal possessions for "luck," etc. "Medicine" and "charm" are very indefinite terms, and, as previously stated, they emphasize the need of an archæologic nomenclature. That we must resort to such expressions in the description of a very important class of prehistoric artifacts is indeed pitiable. These thousands of stone relics of every kind covering, as they do, a greater range in form and size, pattern and purpose, than ornamental or ceremonial stones of prehistoric Europe, certainly deserve a better classification at our hands than is possible at present.

At some future meeting of Section H (anthropology) of the American Association for the Advancement of Science, I trust that a committee will be appointed to devise a scheme of nomenclature. If we are to retain that which seems most plausible from the scant evidence at hand we must incline toward the "woman head ornament" and the "Zuni fetich" theories. Very few bird-stones are found near large bodies of water, and theories like the "canoe prow ornament" are only fanciful.

As has been said, the long slender ones, the more bird-like forms and all having two sets of perforations may have been worn by women. The short ones, the single perforated, or those with transverse ridges, are manifestly charms or dieties. To such were attached the arrows or other property, then they became sacred, or assured the owner of success, etc. If the bird-stone is a woman's ornament, would it also be used for the shamen? I think not. Perhaps, as has been suggested of the two types (like Figs. 1 and 2), the first was worn by women and the second by the priestly class.

CONCLUSIONS.

The distribution of bird-stones is to be considered when, at some future date, archæologists will better understand for what this peculiar type stands. As previously stated, I have accepted Figs. 1 and 2 as indicative of two distinct forms of bird-stones. In my conclusions I am not dealing primarily with those specimens which form "connecting links" between Figs. 1 and 2, but treat of the types themselves. After the first half of this bulletin had been printed, I received a number of communications in answer to questions which had been propounded two or three months ago. I can only mention a few of these. The Cincinnati Art Museum sent photographs of several more or less like Fig. 1, from Southern Ohio and Indiana. The State University and State Historical Society Museum, at Columbus, furnished me with drawings of specimens in their collections.* Information from other collections strengthens me in my conclusions. In case additional facts are brought out in the investigations, which I trust this bulletin will stimulate, I will publish a second edition, for I am aware that the subject is a new one and all the questions cannot be settled for some time.

[Continued from SUPPLEMENT, No. 1265, page 20281.]

IS THE STEERING OF THE MODERN SCREW-PROPELLED VESSEL DEFECTIVE?

By the late CAPTAIN CORNELIUS W. MCKAY.

VIEW the records of marine disasters. Note those of the stern screw-propelling ships that have happened when they have been steaming across currents or against other oblique and deviating forces. Reasoning from effect to cause, take the case of the "Anglo-Saxon," lost in 1863. She was bound for Montreal, and from good solar observations shaped her course to round Cape Race, which then bore west one-quarter south. The wind was south-southeast and the captain set all sail, steering west, one degree south, for eighteen hours. Then he slowed down; for it was thick weather and he knew that he was very close to the land. What he did not know, however, was that the current setting on his port bow had forced him far to the northward; but having confidence in the allowance that he had made for the set of the current "over the ground," and in his log, he swung the ship to the southward (west southwest) in order to round Cape Race and enter the Gulf of St. Lawrence. He had every reason to suppose, when shaping the last course, that he was as clear from the land as if he were in the middle of the ocean. He run the ship for two hours and fetched up in Ciam Cove. One hundred and thirty-seven lives were lost; and the verdict of the investigating board was that the captain should have "taken soundings," "gone slower," and "that a fog signal was wanted off the Cape." The London Times, when traversing the sad disaster, summed up with: "It is satisfactory to know that nothing was wrong with the ship, which seems to have *gone wrong herself*." And this (italics ours) was the story in a nutshell.

Another stern screw-propelling ship that "went wrong" was a White Star liner, the ill-fated "Atlantic," lost in 1873. She was only two years old, 420 feet long, and a crack craft in all respects. She got short of coal, and though bound for New York she changed her course for Halifax, N. S. North was the new course, and the distance, 170 miles, in making which the ship met the Nova Scotia currents that set to the westward. The ship fetched up in thick weather from twelve to thirteen miles to the westward and leeward of her course—a terrible disaster. Four hundred and eighty-one souls perished, and those who were saved never knew how lucky they had been. There was the usual "investigation," of course. The ship's point of departure, when she changed her course for Halifax, was well established by the captain's observations, and, besides, the ship's course when sailing to the northward had been corrected several times by the polar star. The verdict rendered by the board was that, although the course was correct, the captain had "miscalculated the currents" (not his ship), and the lack of vigilance, discipline, etc., on board would have put the ship ashore anyhow. With this decision *ex cathedra*, the matter has been buried.

On the same wild coast soon afterward (July, 1873), the new ship "City of Washington" was wrecked. She, like the "Atlantic," was bound for New York, and met heavy weather from the southward of west from the time she left Queenstown. The captain got no observations after the second day out, but run his ship across the Atlantic Ocean by the compass, meeting heavy seas on his port bow all the time. He steered west northwest and fetched up on the southeast coast of Nova Scotia in the middle of the day and in calm but thick weather. Fortunately no lives were lost, but some of the passengers got wet and they howled. "Where are we?" they all queried of the officers and the captain, as the ship slid up on the only soft spot on the wild coast. "I don't know," was the reply of each and all, and they told the truth. It was a revelation to them. The ship was anywhere from one hundred to one hundred and fifty miles out of her course.

Retrospectively viewed, this affair appears more or less ludicrous. All the officers kept a dead reckoning, and each and every one's account was compared every day with the dead reckoning kept by the captain. No discrepancy was noticed. All the time the seas were pounding the ship's port bow. So much so that one day the captain swung the ship off from her course to meet them. But no use. Under a full head of steam she went ashore. Something was wrong, of course, and the officers of the ship attributed the great error made in the ship's course either to a deviation of the compass or to the currents. But currents sufficient to bolster up such an opinion could not be found on the charts, for a wonder, though the navigators of screw-propelling ships had been for years busy in discovering new currents, or an increased strength in the old ones. The board of inquiry decided that the wreck was caused by deviation of the ship's compass, as she carried some steel and tin in her cargo. They compared the ship's position (by observation) when two days out with a position determined by themselves from the log-book and they found a disagreement. The ship was to the starboard, hence the compass was out. The heavy seas that had been pounding her port bow from the time she left Queenstown were of no moment. But why the deviation of the compass was to the starboard and not to the port hand, these wiseacres did not say. Every officer testified that the ship was a "most excellent ship to steer." Deviation error in a compass is always possible, whether the compass be at sea or on shore. But 'tis obvious as the full moon, when viewed in the light of the probabilities, that on her last voyage the crack Inman ship "City of Washington" steered herself.

It was, indeed, a striking example of the uncertainty which attends in some situations—the steering of stern screw-propelling ships—that of the wreck of the United States surveying steamer "Huron," in 1877. Here was the ship par excellence, perfectly fitted, full of navigating talent, her personnel having been selected for the special purpose of marine surveying; and moreover, from their previous operations in the ship as professional seamen, they knew her thoroughly, as they supposed. The history of marine disasters presents no case of confidence misplaced or of a mistake made that is more grievous than the loss of the "Huron." At noonday she took her departure from Cape Henry Lighthouse, it being five to seven miles abeam, and, steering south by east, three-quarters east, she went down the coast with reefed fore and aft sails. In the teeth of a fresh gale and against considerable sea running from the southeast, she steamed about six knots an hour. She run about fourteen hours with the sea pounding her port bow, fetching up finally off Nag's Head and about 200 yards from the shore. Her commander and all of her watch officers were among the ninety-eight unfortunate beings who lost their lives. The course that the "Huron" steered, if made good, would have taken her to the eastward of where she struck some nine miles, from which it can be seen that the leeway made was about equal to that of a sailing craft. She carried a jib for about eight hours—until it blowed away—which no doubt aggravated the leeway that she was constantly making. But the naval world stood aghast at the fact thus demonstrated that a full-powered, sharp modeled steam craft should "crab to leeward" as the "Huron" did. The board of inquiry—such a board as could be selected only from our navy—bright, intelligent, and experienced seaman all, weighed the clear, direct, and irrefutable testimony given by the survivors. It was proved that the ship was perfect in all that such a craft could be. The board's decision as to the cause of the disaster was that not sufficient allowance had been made for the inset current, and that carrying sail when on a lee shore was unseamanlike. The little confidence the board had in its own conclusion can be read plainly where they sum up with: "Many experienced navigators in well-manned merchant steamers have been lost near the same place."

It was the old ghost story—the "mysterious currents" that run up and down the beach on the coast of North Carolina. But who knew more about these currents than the unfortunate commander of the "Huron," and was not nine miles for the distance (of eighty-two made) a sufficient offset against current, supported, as it was, by the engine power of the ship? It seems not. (But those "currents.")

Take the shipwreck of the "City of Columbus," January, 1884, off Gay Head, Mass., by which one hundred and three lives were lost. As an exemplification of lamentable though honest ignorance—or of nautical confidence woefully misplaced—this disaster with its attending conditions furnished testimony that fairly shrieked to the maritime world. The ship was bound to Savannah, Ga., and when within about an hour's (more or less) steaming from Gay Head, the course was given by the captain southwest by west. A fresh gale was blowing with considerable sea running against her starboard bow; but the ship made her ten knot easily. The night was clear, with the light on Gay Head shining in the ship's pilot house, in which was the officer of the watch and the quartermaster steering—"nothing to leeward"—the course that should have taken the ship, as the captain had calculated, two miles clear of the reef where she finally struck. But the doomed ship, heading her course, was settling down under their feet, as it were, toward the reef, and then the catastrophe; after which, the "investigation." "How do you account for it?" was asked of the unfortunate captain, whose hard-earned reputation of a lifetime as a first-class mariner and pilot had been brushed away in a twinkling. "God only knows," was his reply. Right here was demonstrated that, under certain conditions, the screw-propelling ship does not make her course by compass good, through the water; or, in other words, that she sometimes steers herself.

A later case, and one still fresh in the minds of many people, is the wreck of the "Mohegan," last fall. This new, full powered, twin-screw steamship dashed herself against Vase rock, one of the Manacles—a locality on the south coast of England that is the dread of all British mariners—of such ill-repute that should a coasting skipper happen to drift near there, he hides the vessel's name—covers it over with canvas—so that no report can be made of the contretemps. And yet, the "Mohegan" was piloted (it is believed by many) to this marine graveyard by a British seaman who stood high in his profession, and who lost his life with his ship, and gave no sign. What possibly could have been the cause? The board that investigated the matter decided that it was caused by "steering a wrong course."

No doubt but the "Mohegan" on her way through the English Channel bound to the westward was "steering fine." Her position when off Eddystone Light supports this opinion, for she was then only two and a half miles to the southward of the light, and mid-channel lies nearly as much further off. From this position, however, she steamed (at the rate of twelve knots, it is said) against a flood tide setting on her port bow—having a strong breeze—and following sea running on her port quarter. The ship made a west by north course to the place where she fetched up—but how was she steered? Not a particle of testimony has been adduced to show how the ill-fated vessel was steered—which is lamentable, for many reasons. It is certain that no deviation affected her compasses. This fact has been established by irrefutable testimony. How, then, can this shipwreck be accounted for in anything like a satisfactory manner? Nautical authority has given up attempting to reply to the query. "It is a peculiar case," says the "toilers of the sea"—who refer to other shipwrecks of a like nature that are also "mysteries of the sea." Nothing remains to the non-professional man who is interested in such matters but to weigh the probabilities in all things that actually bear upon the question.

In the first place, what was the probability of the captain's mistaking his course from the charts—if indeed he had to consult them? He was at home; and exercising his profession in water that was peculiarly British. He had, too, an excellent reputation as a seaman, and a man of general intelligence, or he never could have reached the position he did. And, besides all this, professional seamen who have sailed with him as shipmates testify in the most positive manner that he was a "most careful navigator." In view of the situation, it is extremely improbable that he would give a wrong course, or continue steering the one he had been steering. The captain went into the pilot house when off the Eddystone; and he certainly did not go there to continue the course he had been steering—west by north. Did he intend to commit suicide? Possibly he might; but not probably. It has been rumored, too, that he was subject to mental aberration at times, which, even if it be true, has very little weight upon his probable action at that particular time in the pilot house of the "Mohegan." What is known beyond all controversy however, is that the ship was well to the northward when off the Eddystone; that she had the flood tide setting on her port bow; and a strong gale from the southeast (with its consequent sea) abaft the port beam; and that she was in light trim.

It is respectfully submitted to the expert nautical world that the channel current and the southeast fresh gale were leewardly forces acting upon the ill-fated ship: and that her port propelling wheel and her rudder, in their combined effect, were anything but weatherly. From her position off the Eddystone to the place where she struck it is, in direction, west by north: Ergo—she was steered west by north, say some people. The writer humbly submits that, in view of the conditions prevailing at the time, if she had been steered west by north, the ship would have struck the land further to the northward than she did; and the fact that the place where she was wrecked lies west by north of her last well known position (off the Eddystone) supports the view that the ship was steered something higher (south of) than west by north, but alas!—not high enough.

What put the American Line steamship "Paris" ashore? Since this noted craft stranded on the Cornwall coast, May 21, 1899, unlimited speculation has been indulged in regarding the exciting cause of her mishap. Fortunately—Oh! how fortunately—no lives were lost; in gratitude for which the saloon passengers, who had been in the very jaws of death, when in company assembled at Falmouth, engaged in silent prayer. Silence seems to have been the order of the day, for the captain and his crew were as dumb as clams to all reasonable and courteous inquiries about the affair. Forty-one days after the stranding some

* I wish to thank Prof. Mills, of the latter museum, and Mr. Gest, of the Cincinnati Museum, for their co-operation.

nautical persiflage—yelept a "report"—by the captain and addressed to the United States Inspectors of Steam Vessels was made public. In this "report" Captain Watkins assumes the full responsibility for the accident. "The casualty," he says, "was owing to an unaccountable error on my part." About one thousand more words relating to his pedigree and the topography of the rocks upon which the ship was then resting, together with some exquisitely minute details regarding the departure from Cherbourg, make up the "report." The United States officials, no doubt, appreciated to the full the latent humor in this remarkable marine document, but they objected to the facetious old sea-dog's trigonometry. The "unaccountable error" of Captain Watkins would not account for his being set in to the northward of his course some seven miles, said the United States Inspectors. "The officers of the line (subsidized) have known from the first that Captain Watkins' error in a simple calculation was the cause of the stranding of the 'Paris,'" said a morning newspaper; and in view of the peculiar nature of the "report" few people will be disposed to dispute that assertion

It was no error—"unaccountable" or otherwise—on the part of the captain that stranded the "Paris." His record shows beyond all contradiction that no more intelligent, skillful and careful mariner ever trod the deck of an Atlantic steamship. He was simply contending with forces the knowledge of which is without the province of the navigator—as the art is practised to-day aboard the vessels of the merchant marine. "The pitcher that goes too often to the well is broken at last"; and the "Paris" under the direction of her skillful and popular captain "got there."

View the conditions: She is the longest and sharpest ship at the bow (relative to the stern) afloat, barring her twin sister, the "New York." On that eventful trip she was sailing in light—very light—trim, and, of course, was well down by the stern. In laying her course to the westward the ship butted the flood tide of the English Channel for five hours, besides meeting a heavy ground swell consequent to a gale that had been blowing for some days from the southwest. All this, too, on her port bow—an insiduous aggregation of a deflective force, whose effect could not be measured or gaged except by a reference to some landmark—and the weather was thick. Whatever may have been the course steered after she left Cherbourg the "Paris" did not make it good, but, in obedience to the mechanical-philosophical laws of fluid resistance she "crabbed" to the leeward, or to the starboard, and ran ashore. It is possible that in her long career the "Paris" had never before encountered the complex combination of those interdependent physical elements—speed, tide, trim, wind and waves—in their relative amount, degree and direction, that caused her stranding. It is certain that if she had ever met this fortuitous combination of causes before her stranding, its particular effect on her behavior had not been either noticed or recorded for future reference. To argue otherwise would be a reflection upon Captain Watkins' general intelligence—that is not warranted by his career as a seaman. Allowance was made, no doubt, for the prevailing current, according to the Admiralty charts, the captain's personal experience, and the usual canons of current sailing. But it was not enough; though the "Paris" had on the port hand, to the southward of the Lizzard, a sea room of nearly one hundred miles of deep blue water. Like in the past, this mysterious stranding of the "Paris" will benefit no one. Steamships will continue to run in thick weather the world over, and incur, besides the perils of the broad Atlantic, the far more dangerous hazards of the English Channel, which is, beyond all contradiction, the most crowded and dangerous marine highway on the face of the globe. And moreover—with the increase in the size and the speed—as well as in the number of steam vessels, the danger to travelers on the narrow seas is becoming greater every year. The English Channel is no place for these long, stern-screw-wheel propelling ships to meander about in thick weather; at least, not until some other method or system than the present pre-Adamite nautical practice is devised to govern, direct and estimate a ship's way through the water—laterally as well as longitudinally.

The modern steamship is a machine that under the guidance of human intelligence should be made to register her each and every motion automatically. The writer does not agree with The London Times, of May 12, 1899, that the "mechanical navigation" of the modern steamship, "which is more dangerous in the English Channel than anywhere else," enhances all the faults in the old method of dead reckoning. These large, high-speed steamships on the Atlantic ferry should be studied experimentally—like the modern warships are—before thousands of lives are committed (passage prepaid) to their keeping. This proposition entails expense and, of course, will be obnoxious to the commercial spirit of greed, which should be forced, in some way, to freight nothing but passengers and mails in these "six-day" steamers, and to avoid the English Channel in thick weather.

CUPRIC SULPHATE AS A REMEDY FOR MILDEW.

THE employment of cupric sulphate in the proportion of 250 grammes to 100 liters of water has been proposed for the preservation of vines from mildew. This process has been employed, say Le Phosphate, in Tarn and elsewhere. The result might be anticipated by the simple recollection of the fact that all the copper is soluble; hence its action against mildew would be very energetic; but the proportion of 250 grammes, it is said, must not be exceeded, for otherwise the acid reaction would injure the vegetation.

Notwithstanding this perfect solubility and the influence against mildew, an inconvenience arises from the solubility itself; for rain washes the copper from the leaves, although a little remains. Another inconvenience is the failure to show its presence. On account of this the work cannot be will managed. It is the avoidance of this trouble which has caused some cultivators to use copper in access, as in the Bordeaux mixture, which contains 3 kilogrammes of cupric sulphate. The present prices, however, compel the cultivator to suppress this useless prodigality; but small quantities of cupric solutions can be employed, with frequent applications, at a great saving of expense, and without impairing the effect of the treatment.

While regarding as conclusive the experiments of M. Marius Jaur, the facility of removal by the rain and the absence of apparent traces after treatment, are serious objections to the simple solutions. To remedy the two defects, the addition of an adherent matter is required, which will not impair the efficiency of a small quantity of the sulphate.

Dr. Trabut, who has investigated this subject, has found that the galipot or dry resin exuding from the pines in Algeria, which has but little value in the eyes of the natives, as well as the mucilage extracted from the stems of the fig tree of Barbary, are two excellent vehicles for fixing the cupric solution. With these materials Dr. Trabut has prepared two mixtures having small quantities of the sulphate.

The first, which is called the "galipot soap mixture," is composed of galipot, 1 kilogramme; crystals of soda or potassium carbonate, 500 grammes; cupric sulphate, 500 grammes; water, 100 liters.

The second, which is a cupric mucilaginous preparation, is composed of twigs of the fig tree cut in pieces, 3 to 5 kilogrammes; cupric sulphate, 300 grammes; water, 100 liters.

The galipot soap is prepared by heating 1 kilogramme of the galipot with 500 grammes of crystals of soda or potassium carbonate, producing a concentrated solution, which can be preserved in the liquid state, and to which the dissolved sulphate is added. To render its presence more perceptible, a small quantity of milk of lime can be added.

The second preparation is obtained by extracting by maceration the mucilage from 3 to 5 kilogrammes of the excresences of the Barbary fig tree cut in pieces; then the simple solution of cupric sulphate is poured into the mucilaginous matter. The preparation, says Dr. Trabut, adheres well to the leaves of the vine and is well distributed. It costs from 15 to 25 centimes per liter.

With these proportions a saving of from 50 to 80 per cent. of the sulphate is realized, and the prevention of mildew is guaranteed.

A SMOKELESS MAGNESIUM POWDER AND NEW FLASH-LAMP.

THE magnesium powders used in photography leave no solid residue after combustion, and consequently present the serious inconvenience of being converted almost entirely into smoke which is disagreeable to inhale, injurious to pictures, and does not permit of taking two negatives in succession without first thoroughly ventilating the apartment. This causes loss of time and necessitates costly installations, which, although more or less practical, are always cumbersome.

M. CHARLES HENRY'S MAGNESIUM FLASH-LAMP.

M. Charles Henry has solved the problem of a sufficiently rapid and very actinic smokeless magnesium powder, in which the highly actinic violet light produced by the ordinary magnesium powder is modified in such a way that the general effect upon orthochromatic plates is more like that produced by daylight.

The problem could not be solved by chemical means alone. In the case of carbon and organic materials, the smoke is always due to incomplete combustion. The smoke given off by magnesium flash powders is produced in an altogether different manner. It is caused by a projection of the particles of magnesia resulting from the violence of the combustion; that is to say from superoxygenation. The magnesia formed is only fusible in temperatures obtained in the electric furnace.

The more energetic the oxydants contained in a magnesium powder, the more rapid is its combustion and the more smoke it produces. If, to avoid the smoke, recourse is had to feeble oxydants, the rapidity of the flash is also reduced. M. Henry has succeeded in obtaining the necessary rapidity by producing a high elevation of temperature, which increases the speed of the chemical reaction. His powder contains, also, besides the oxydant which yields to the magnesium, the exact amount of oxygen necessary, an energetic comburent (a substance that combines with the evolution of light and heat), which disengages a considerable quantity of heat.

The accompanying figure, from La Nature, shows the arrangement employed for producing the flash. *A* is an iron saucer that is heated red hot before the powder is placed in it. *B* is a woven wire hood for collecting the grains of magnesia resulting from the combustion of the powders. The alcohol torch, *C*, heats the saucer, *A*. The iron ladle, *D*, is used for depositing the powder upon the saucer. *E* is a small cup for measuring the amount of alcohol to be poured into the torch; *F* is a bottle of magnesium powder containing ten charges, and *G* is a bottle of alcohol.

A cupful of alcohol is poured into the torch, which is then closed by a metallic stopper provided with a blowpipe nozzle. A few drops of alcohol placed upon the blowpipe and ignited with a match cause an intensely hot flame to issue from the nozzle and raise the saucer to a red heat. A charge of magnesium powder is then placed in the latter by means of the ladle, and the flash immediately occurs.

After having given off its oxygen, the very energetic oxydant contained in the powder is converted into a substance which, on becoming softened by the heat, instantly combines with the magnesia and prevents the production of smoke. The grains of magnesia projected by the flash are caught by the wire gauze hood placed above the saucer.

The heat shortens the time of the flash, making it a sudden, brilliant, burst of light; and, finally, while yielding its oxygen in the essentially reducent medium of the products of combustion of the comburent, the oxydant emits a bright greenish light which corrects the too exclusively violet light of the magnesium; so that photographs made on isochromatic plates preserve the color values as completely as when the exposures are made by sunlight. As it contains no phosphorous nor chlorate of potash, the new powder does not disengage any products that are malodorous or dangerous to breathe, and it is also not exploded by shocks.

For cases in which the absence of smoke is of no consequence, M. Henry has prepared a very rapid actinic powder that does not require the use of a flash-lamp and that emits considerably less smoke than the ordinary powders—say 45 instead of 90 or 95 per cent. These percentages represent the difference between the weights of the charge before the combustion and the weight of the solid residue after the flash, divided by the weight of the charge.

A special support has been devised for operations that require the elevation of the light to a certain height, and this allows the foot of the lamp to be raised to about six feet from the floor. In another arrangement, several lamps are united for the illumination of wide surfaces. In this case each apparatus is fitted with a small cigar-shaped charge chamber, in which the powder is placed. One end of the chamber is connected to a curved tube placed a short distance above the small iron saucer, and the other end is connected by flexible tubing to a common bulb. When the bulb is squeezed, the powder of the several apparatus is blown simultaneously into the heated iron saucers and the several flashes obtained at once.

TOOTH POWDERS.

By W. A. DAWSON.

THE VARIOUS BASES.

A PERFECT tooth powder that will thoroughly clean the teeth and mouth need contain but few ingredients and is easily made. For the base there is nothing better than precipitated chalk; it possesses all the detergent and polishing properties necessary for the thorough cleansing of the teeth, and it is too soft to do any injury to "soft" or to defective or thinly enameled teeth. This cannot be said of pumice, cuttlebone, charcoal, kieselguhr, and similar abradants that are used in tooth powders. Their use, indeed, is reprehensible in a tooth powder that is used from one to three or four times a day by people with all sorts and conditions of teeth. The use of pumice or other active abradant is well enough occasionally, by persons afflicted with a growth of tartar on the teeth, but even then it is best applied by a competent dentist. Abrading powders probably have as much to answer for as twentieth century modes of living, in hastening the day of the prophesied toothless race.

Next in value comes soap. Powdered white castile soap is usually an ingredient of tooth powders. There is nothing so effective for removing sordes or thickened mucus from the gums or mouth. But used alone or in too large proportions, the taste is far from pleasant. Orris possesses no cleansing properties, but is used for its flavor and because it is about the most effective thing for masking the taste of the soap. Sweetening and flavor help to make a pleasant tasting preparation. Sugar or saccharin may be used for sweetening, and for flavoring almost anything can be used. Flavors should, in the main, be used singly, though mixed flavors lack the clean taste of simple flavors. When I went to the art school the instructor used to say: "In mixing colors, remember this, one color is fine, two colors are good, three colors are poor, and four colors mixed together make mud," and I have found it pretty much so with flavors.

THE MOST POPULAR TOOTH POWDER

sold is the white, saponaceous, wintergreen flavored powder, and here is a formula for this type:

Precipitated chalk	1	pound.
White castile soap	1	ounce.
Florentine orris	2	"
Sugar (or saccharin 2 grains)	1	"
Oil of wintergreen	¼	"

The first four ingredients should be in the finest possible powder and well dried. Triturate the oil of wintergreen with part of the chalk, and mix this with the balance of the chalk. Sift each ingredient separately through a sieve (No. 80 or finer), and mix them well together, afterward sifting the mixture five or six times. The finer the sieve and the more the mixture is sifted, the finer and lighter the powder will be.

This powder will cost only about 15 cents a pound, or, say, a cent an ounce complete.

THE PACKAGE.

It is customary to put up tooth powders in 2-ounce bottles which retail at 25 cents. Most proprietary powders retail at that price, and are usually sold in all sorts of stores at cut prices. The fancy bottles generally used cost from 4 to 10 cents each, and as the powder costs but 2 cents the profit is large. But successfully to compete with the proprietary powders you had better put your powder up in 4-ounce bottles

Your profit would still be large, as the bottles cost about the same for either size, and you can offer the inducement of a double-sized package. Another method of putting up is in 2-ounce, turned wood boxes, and retailing them at 10 cents. I have sold the same powder both ways, and I have discovered that the people who buy the box powder buy more dollars worth in a year than those who buy the 25-cent bottles. I don't know why unless it is that it seems so much cheaper and they use it more freely.

Here is a formula for a

PINK, ROSE FLAVORED POWDER

of the Caswell and Hazard, Hudnut, or McMahan type, once so popular in New York. I got it from W. H. Youngs, the founder of the "Longacre Pharmacy" at Broadway and Forty-third Street, when I was employed there fifteen years ago. I have changed the formula somewhat, leaving out the cuttlebone, of which it originally contained 20 per cent. It was made in two styles, with and without soap.

Precipitated chalk	1	pound.
Florentine orris	2	ounces.
Sugar	1½	"
White castile soap	1	"
No. 40 carmine	15	grains.
Oil of rose	12	drops.
Oil of cloves	4	"

Dissolve the carmine in an ounce of water of ammonia and triturate this with part of the chalk until the chalk is uniformly dyed. Then spread it in a thin layer on a sheet of paper and allow the ammonia to evaporate. When there is no ammoniacal odor left, mix this dyed chalk with the rest of the chalk and sift the whole several times until thoroughly mixed. Then proceed to make up the powder as in the previous formula, first sifting each ingredient separately and then together, being careful thoroughly to triturate the oils of rose and cloves with the orris after it is sifted and before it is added to the other powders. The oil of cloves is used to back up the oil of rose. It strengthens and accentuates the rose odor. Be careful, however, not to get a drop too much, or it will predominate over the rose.

A VIOLET TOOTH POWDER.

Violet being all the rage now, violet perfumes, soaps, ammonias, toilet powders, and tooth powders are popular, so here is a formula:

Precipitated chalk	1	pound.
Florentine orris	4	ounces.
Castile soap	1	"
Sugar	1½	"
Extract of violet	½	"
Evergreen coloring R. & F	q. s.	

Proceed as in the second formula, dyeing the chalk with the evergreen coloring to the desired shade before mixing.

CAMPHORATED AND CARBOLATED POWDERS.

A camphorated tooth powder may be made by leaving out the oil of wintergreen in the first formula and adding 1½ ounces of powdered camphor.

Carbolated tooth powder may likewise be made with the first formula by substituting 2 drachms of liquefied carbolic acid for the oil of wintergreen. Carbolic acid, however, slowly combines with the chalk, and the tooth powder gradually loses the odor and taste of the acid. It is not of much utility any way, as the castile soap in the powder is of far greater antiseptic power than the small amount of carbolic acid that can safely be combined in a tooth powder. Soap is, in fact, one of the best antiseptics, as recent experiments on bacteria have shown.

Alkaline salts, borax, sodium bicarbonate, etc., are superfluous in a powder already containing soap. The only useful purpose they might serve is to correct acidity of the mouth, and that end can be reached by the much better method of rinsing the mouth with a solution of sodium bicarbonate. Acids have no place in tooth powders, the French Codex to the contrary notwithstanding, so we will not discuss them.

PEPPERMINT AS A FLAVOR.

Speaking of French Codex reminds me to say that in France, and all over the continent as well, peppermint is the popular flavor, as wintergreen is in this country. They call wintergreen "teaberry" over there. Go into a French pharmacy and buy a franc's worth of "poudre pour le dents," and it will be so strong of peppermint that after using it once you will smell like a peppermint field. I do not care for mint, but for those who do it can be substituted for the oil of wintergreen in the first formula.

English apothecaries use sugar of milk and heavy calcined magnesia in a good many of their tooth powders. Neither has any particular virtue as a tooth cleanser, but both are harmless. Cane sugar is preferable to milk sugar as a sweetener, and saccharin is better still; it should be used in the proportion of 2 to 5 grains to the pound of powder, and great care taken to have it thoroughly distributed throughout the powder.

AN ANTISEPTIC TOOTH POWDER

containing the antiseptic ingredients of listerine is popular in some localities.

Precipitated chalk	1	pound.
Castile soap	5	drachms.
Borax	3	"
Thymol	20	grains.
Menthol	20	"
Eucalyptol	20	"
Oil of wintergreen	20	"
Alcohol	½	ounce.

Dissolve the thymol and oils in the alcohol, and triturate with the chalk, and proceed as in the first formula.

One fault with this powder is the disagreeable taste of the thymol. This may be omitted and the oil of wintergreen increased to the improvement of the taste, but with some loss of antiseptic power, for thymol is one of the best mouth antiseptics.

Menthol tooth powder makes a nice preparation. It leaves a cool and pleasant sensation in the mouth that feels delightfully clean. It is excellent for fetid breath. To make it add to the first formula a drachm each of menthol and oil of wintergreen dissolved in a half-ounce of alcohol.—Bulletin of Pharmacy.

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TABLE OF CONTENTS.

PAGE

I. ARCHÆOLOGY.—The Bird-Stone Ceremonial.—13 illustrations... 20296

II. AUTOMOBILES.—Compound Road Locomotives for the War Office.—1 illustration... 20291

III. COMMERCE.—Trade Suggestions from United States Consuls... 20292

IV. ELECTRICITY.—A Novel Application of Electric Heat.—By E. J. HART... 20294

V. MECHANICAL ENGINEERING.—The Robinson Shaft Governor.—1 illustration... 20291

VI. MISCELLANEOUS.—Mammoth Cave Maps... 20292
Trade Notes and Receipts... 20293
Selected Formulæ... 20293
Miscellaneous Notes... 20294

VII. NAVAL ENGINEERING.—Destroyers for the Japanese Navy.—1 illustration... 20295
Is the Steering of the Modern Screw-Propelled Vessel Defective?—By the Late Capt. CORNELIUS W. MCKAY... 20300
The Classification of Warships.—By FRED. T. JANE... 20296
The Submarine Torpedo-Boat "Le Goubet."—1 illustration... 20295

VIII. ORDNANCE.—English Artillery in the Transvaal.—2 illustrations... 20294

IX. PHARMACY.—Tooth Powders.—By W. A. DAWSON... 20304

X. PHOTOGRAPHY.—A Smokeless Magnesium Powder and New Flash-Lamp.—1 illustration... 20301

IX. RAILWAY ENGINEERING.—Railways in the Philippines... 20291

XII. SANITARY ENGINEERING.—The Sewerage Problem of the City of Worcester, Mass.—3 illustrations... 20298

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